Appendix G: Safety Background Report

Appendices

This page intentionally left blank.

County of San Bernardino

Safety Background Report

4/5/2017

Prepared by:

PlaceWorks

In Collaboration with Dudek on Fire Hazards

This Background Report was prepared to inform the Countywide Plan and is not intended to be continuously updated.

Table of Contents

Table of Contents

LIST OF TABLES

Table of Contents

LIST OF FIGURES

1. PUBLIC SAFETY CONTEXT

1.1 INTRODUCTION

Public safety is a significant challenge for all California, including San Bernardino County. Since 2000, the County has experienced hundreds of storms that have caused an estimated $2 billion in damages (HVRI 2015). Although damaging earthquakes are less frequent, the 1992 Landers Earthquake resulted in more than $100 million in damages. Hazard models predict that earthquakes along other active faults could cause billions in damages (SBC, 2016). Since 2000, wildfires have caused $1.5 billion in damages in suppression costs (HVRI 2015). These costs only reflect damages from some natural hazards and do not include the costs to maintain and operate infrastructure, facilities, and County services.

Flash flooding during a recent storm overflows the banks of a local stream.

Flash flooding during a recent storm overflows the banks of a local stream.

Human-caused hazards are of equal concern. The state and federal governments will spend $725 million through 2050 to clean up five of the County's 75 Superfund sites and an additional $300 to $400 million to remediate 54 formerly used defense sites (USACE, 2015). Public safety extends to the County's highways, railroads, bridges, and dams. The California Department of Transportation reports that more than 150 bridges are structurally deficient or obsolete and are in need of rehabilitation or replacement (Caltrans, 2015). The Army Corps of Engineers (USACE) also reports that only one of the 33 levees in the county is in acceptable condition. Finally, the state and federal government spend millions of dollars annually in groundwater cleanup activities (USACE, 2015).

In this context, the County Board of Supervisors has adopted a vision of a complete county offering a full range of services and quality of life. Public safety is a prerequisite; all the benefits or public goods necessary for a high quality of life—culture, civic life, strong vibrant neighborhoods, education and employment, economic prosperity—are difficult to achieve when health and safety are threatened or compromised. Public safety is also directly related to the County's resilience—its ability to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption or disasters.

The natural and man-made hazards countywide underscore the challenge facing San Bernardino County in protecting people, property, and the environment from potential harm and loss; providing responsive services when needed; and working collaboratively to mitigate and recover from disasters. This requires that the County: 1) understand the public safety threats facing it; 2) be proactive and intentional to

protect itself against hazards; and 3) build greater self-sufficiency through infrastructure and systems that will make the County more sustainable and self-reliant over the long term.

1.2 PURPOSE AND ORGANIZATION OF REPORT

The Safety Background Report provides relevant information to identify the potential risk of death, injury, property damage, and economic and social dislocation resulting from fires, floods, earthquakes, landslides, and other hazards. The Safety Background Report also serves as a reference for the Countywide Plan and a statement of existing conditions for the Environmental Impact Report (EIR).

The Safety Background Report is organized as follows:

- **Chapter 1, Introduction.** This chapter introduces the topic of hazards and its relationship to public safety and resiliency, outlines the scope of this report, summarizes findings, and highlights public safety topics that could be further investigated.
- **Chapter 2, Seismic and Geology Hazards**. This chapter identifies geologic and seismic hazards, including and includes a discussion of regulations, geologic and seismic profile of the county, primary seismic and geologic hazards, and mapping showing areas of concern.
- **Chapter 3, Flooding and Inundation Hazards**. This chapter identifies flooding hazards in San Bernardino County and includes a discussion of regulations, hydrologic profile of the county, primary flooding hazards, and mapping areas of concern.
- **Chapter 4, Hazardous Waste**. This chapter identifies public safety concerns related to hazardous materials and wastes and discusses the generation, recycling, transport, disposal, and cleanup of hazardous wastes that can harm people, property, and the environment.
- **Chapter 5, Fire Hazards**. This chapter identifies and describes the various fire hazards for wildlands and urban areas in San Bernardino County and provides an overview of the agencies responsible for fire protection.
- **Chapter 6, Emergency Preparedness**. This chapter outlines the County's broad emergency preparedness program, including hazard mitigation, to address specific hazards noted in this report. Further information can be found in referenced documents.
- **Chapter 7, References**. This includes a list of references for the material and conclusions presented in the report. Also included is a list of abbreviations used in the text.

This background report is a technical compilation of a wide range of topics on public safety hazards that should inform decisions to manage and reduce risks to people, property, and the environment. However, its intent is not as an all-encompassing compendium, but rather is an identification, analysis, and discussion of hazards in San Bernardino County to improve decisions about risks in the context of planning the future of San Bernardino County.

1.3 REPORT FINDINGS

1.3.1 SEISMIC AND GEOLOGIC HAZARDS

San Bernardino County is traversed by dozens of potentially active faults that can be the source of damaging earthquakes; the region has a 75 to 99 percent chance of an earthquake exceeding a magnitude of 7 during the next 30 years. Due to its diverse topography, San Bernardino County is also subject to geologic hazards, ranging from landslides and debris flows in the mountains to subsidence, liquefaction, and corrosive soils in the valleys and deserts. Table 1-1 summarizes seismic and geologic hazards, specific issues, and opportunities to address them.

Table 1-1. Seismic and Geologic Hazards: Summary of Issues and Opportunities

Seismic Hazard	Hazard Assessment Seismic hazards are a significant issue for San Bernardino County. Modeled earthquakes on the San Andreas, Puente Hills, San Jacinto, and other faults could cause billions of dollars in damages and significant loss of life. Although ground shaking produces the most damage, other seismic and geologic hazards could include liquefaction, settlement/subsidence, landslides and slope instability, corrosive soils, expansive soils, and hazardous minerals. The County Hazard Mitigation Plan assesses the frequency and severity of seismic and geologic hazards. Based on that assessment, the probability of a significant threat and impact to the public, property, and environment is very high.	
	Issues	Opportunities to Consider
Hazard Identification	County geologic hazard (GH) overlay maps identify active faults and Alquist-Priolo Zones in San Bernardino County, except in the easternmost portions of the County. The California Geologic Survey has not produced regulatory maps for landslides and liquefaction within the County. County GH overlay maps cover only limited areas. No regulatory maps are available for radon, methane, arsenic, lead, uranium, asbestos or other naturally occurring hazardous minerals or soils.	Update maps to include the latest revisions to fault maps and AP zones. Consider including shake map scenarios in determining seismic hazard zones. Update hazards maps to document landslides, debris flow, and liquefaction, land subsidence, and expansive/collapsible soils; consider inferring liquefaction hazards from groundwater table data. Work with the California Department of Public Health and California Geologic Survey to prepare hazardous minerals/soil surveys in San Bernardino County.
Land Use Regulations	The general plan land use compatibility matrix is used to evaluate the appropriateness of specific land uses in seismic and geologic hazard areas. County GH overlay regulations require geotechnical reports and mitigation for applicable projects prior to permit approval. County follows the building standards required by the California Building Code to address seismic and geologic concerns.	Consider updating and refining the land use compatibility matrix to include recognized degrees of hazard severity that are used by the state or federal government Although higher seismic performance is not guaranteed by simply increasing code requirements, there are ample examples where cities have enacted more stringent codes for known higher-risk buildings. Consider improving standards for precast concrete or tilt-up concrete structures, soft-story buildings, and mobile homes, among other building types.
Other Observations	A significant number of mobile home parks are subject to earthquakes, but are not required to brace units to withstand such events. Critical facilities, infrastructure, and lifeline services are at risk of damage. This includes schools, hospitals, essential facilities, fire and police stations, government buildings, etc. Few retrofit programs address structurally deficient buildings and infrastructure, so most retrofits are done on a voluntary basis unless required by the state/federal government.	Consider voluntary, County-assisted, or grant-funded rehabilitation programs to brace mobile homes to protect occupants from earthquake hazards. Work with schools, hospitals, Caltrans, and other entities to accelerate the improvement of the structural integrity of facilities and adherence to seismic safety retrofit laws. Conduct a survey of best practices in southern California that identify best practices that the County could implement to address long-standing seismic and geologic hazards.

1. Introduction

1.3.2 FLOOD HAZARDS

Flooding affects every region in San Bernardino and the majority of communities. The County's regulatory process involves: 1) the identification of flood hazards through overlay maps; 2) guidance in the general plan on land use compatibility; 3) zoning requirements for regulating land uses; 4) building codes to address statewide minimum building standards; and 5) mitigation programs. Table 1-2 summarizes flooding hazards and specific issues and opportunities to address them.

Table 1-2. Flooding Hazards: Summary of Issues and Opportunities

Flood Hazard	Hazard Assessment Flood hazards continue to be a significant issue in San Bernardino County. Since 2000, an estimated 272 reported flooding events have caused 54 injuries and fatalities and a conservative estimate of $233 million in damage. Flood hazards include those from inclement weather (most often riverine flooding), dam and levee failure or breach, urban flooding, alluvial fan flooding, and debris and mud flows (particularly following fire events). The County Hazard Mitigation Plan assesses the threat of flood hazards countywide. Based on that assessment, the probability of a significant threat and impact to the public, property, and environment is very high.	
	Issues	Opportunities to Consider
Hazard Identification	County floodplain safety overlay maps show 100- and 500-year floodplains identified by FEMA, and inundation zones for most dams.	Update County FP overlay maps to include the latest data and map revisions; update maps to include DWR's 100-year data and dam inundation zones to further identify potential hazards.
	Flood and/or inundation hazard maps have not been prepared for levees, alluvial floodplains, or other areas that may be subject to flooding.	Update overlay maps to delineate areas protected by levees; consider amending FP maps to include alluvial floodplains; require appropriate geotechnical study.
	FEMA classifies large swaths of the county as Zone D, which means flood maps have not been prepared or flood risks are unknown.	Work with FEMA, DWR, or other agencies to complete surveys of county areas that are designated Zone D, or automatically incorporate Zone D into the FP3 zone.
Land Use Policy and Regulations	Land use compatibility matrix in the safety element addresses the suitability of certain land uses within the 100-year floodplain.	Review and update land use compatibility matrix to address other types of flood hazards, such as the 500-year floodplain, alluvial fans, and other flood-related hazards.
	County-adopted flood safety overlay district to serve as a floodplain management ordinance, which is updated as needed.	Revise floodplain safety overlay district regulations to incorporate 3-foot federal building elevation standard; consider extending standard for nonfederal land uses.
	County follows minimum statewide standards in the California Building Code to protect from flooding hazards.	Consider amending the County Code to enhance building, site design, and safety requirements to address flooding hazards unique to the county, such as alluvial fans.
Other Observations	A significant number of mobile home parks are in or near floodplains, but are not required to brace units to withstand flooding.	Consider voluntary or County-assisted (or grant funded) rehabilitation program to brace mobile homes to protect occupants from flooding hazards.
	Significant critical facilities, infrastructure, and lifeline services are located in flood zones and may be at risk of damage.	Assess critical facilities, infrastructure, and lifeline services for flood hazards; consider prohibiting new facilities, relocating existing facilities, and requiring mitigation.
	Most "high-hazard" county dams have not prepared emergency action plans or have not submitted the plans to CAL-OES.	Consider requiring or encouraging preparation and submittal of emergency action plans for high hazard dams or require plans as a condition of discretionary permits.
	Many levees are not in "acceptable condition" of maintenance, and several dams have received lower than desired safety ratings.	Ensure routine inspection, cleaning, and repair of basins, channels, and other infrastructure; collaborate with the USACE and DWR to monitor dam and levee safety.

1.3.3 HAZARDOUS MATERIALS

San Bernardino County is home to many landfills, Superfund sites, and thousands of businesses that manufacture, use, dispose, or transport hazardous materials or waste products. Hazardous and toxic wastes are transported along freeways, railroads, and pipelines. Hundreds of millions of dollars are allocated each year to control, manage, mitigate, and reduce the risks from hazardous materials. Table 1-3 summarizes hazardous material threats and specific issues and opportunities to address them.

Table 1-3. Hazardous Materials: Summary of Issues and Opportunities

Hazardous Materials	Hazard Assessment San Bernardino is subject to numerous safety hazards from hazardous materials. The federal, state, and local governments spend hundreds of millions of dollars each year to safeguard the public and environment. Hazardous material incidents could be due to the generation of wastes, storage of wastes, transportation of materials (by highways, pipeline, and rail), cleanup of spills and accidents, and the safe disposal or recycling of hazardous wastes. The County Hazard Mitigation Plan does not rate the frequency or severity of hazardous material incidents. Based on occurrence, the probability of a significant threat and impact to the public, property, and environment is very high.	
	Issues	Opportunities to Consider
Hazard Identification	The County uses a hazardous waste overlay that is applied concurrent with a conditional use permit to site hazardous waste facilities. No County hazard maps are publicly available that identify pipelines, high voltage transmission lines, and other similar hazards. No hazard overlay district maps are available to identify known or potential threats to air, water, or land from hazardous materials.	Create a new hazard overlay that addresses hazardous materials (waste facilities, cement plants, utilities, etc.) known to produce significant pollutants and health hazards. Create an infrastructure hazard map that identifies railroads, underground pipelines, overhead transmission lines, mines, and other hazards to existing and new development. Work with state and federal regulatory agencies to compile information and explore the development of additional overlay districts as appropriate.
Land Use Policy and Regulations	The general plan's land use compatibility matrix guides siting of businesses that use, handle, or manufacture hazardous material in areas with flooding, seismic/geologic, and aviation hazards. The County largely defers to the EPA, SWRCB, AQMD, CARB, and other appropriate regulatory agencies to address land uses regulations that affect air and water quality. The County appears to defer to other entities to site natural gas and liquid hazardous material transmission pipelines. These pipelines are allowed anywhere in the RC designation.	Explore creating a defined land use compatibility matrix that addresses the suitability of certain land uses near sources of noise, air, and water pollution. Where not preempted by federal law, work with Federal Energy Regulatory Commission to influence the siting of interstate natural gas transmission lines through the findings of necessity and convenience. The County should be directly involved in dictating the siting of intrastate natural gas transmission pipelines and the siting of all liquid hazardous materials pipelines. Refine the RC land use designation to limit the siting of hazardous waste generators or pipelines to only portions of the RC designation or create buffer protection zones.
Other Observations	Legacy and current defense-related operations are the largest and most extensive hazardous waste sites that require remediation. Complete information about small water systems and private wells that may be contaminated is not available to readily inform land use policy. Ensuring the safe operation and cleanup of underground storage tanks presents an ongoing compliance issue for the County.	Continue to monitor progress and work with federal entities to expedite cleanup of FUDS, Superfund sites, and other contamination from closed and active defense uses. Create detailed map showing the location of septic tanks, private wells, and leach ponds to monitor water quality and enforce compliance with county regulations. Work with SWRCB to achieve 100% compliance with businesses that use USTs, particularly those with LUSTs. Continue to support the abandoned LUST program.

1. Introduction

1.3.4 FIRE HAZARDS

Due to its varied terrain and vegetation, San Bernardino County remains at significant risk of wildfires. The County's fire protection process involves: 1) the identification of fire hazards through overlay maps; 2) the requirement of overlay district regulations for various land uses; 3) implementation of building codes to address statewide minimum building standards; and 4) mitigation programs. Table 1-**4 summarizes fire hazards and specific issues and opportunities to address them.**

Table 1-4. Fire Hazards: Summary of Issues and Opportunities

Fire Hazard	Hazard Assessment Fire hazards continue to be a significant issue in San Bernardino County. Since 2000, an estimated 77 wildfire events have caused 142 injuries and fatalities and a conservative estimate of $1.5 billion in damage. Fire hazards include those from wildfires, urban fires, search and rescue, ambulance and paramedic, and other emergency response services provided in the county. The County Hazard Mitigation Plan rates fire hazards as having a high probability of occurrence with an estimated high risk to damage personal property, threaten public safety, and harm the environment.	
	Issues	Opportunities to Consider
Hazard Identification	Fire safety overlay maps (FS-1, FS-2, and FS-3) identify fire severity levels that correspond to fire safety hazards identified in CAL FIRE maps. No fire hazard overlay maps or other maps are currently available that address urban fires, emergency services, or other threats.	Work with the Board of Forestry and Fire Protection to update FS-1 boundaries given new development that has occurred since very high fire hazard zones were updated. (Changes already recommended of April 2017.) Consider incorporating post burn areas identified by USGS into the fire safety overlay district or post information on the City's emergency operations website.
Land Use Policy and Regulations	While the County had adopted land use compatibility charts for critical, essential, high occupancy, and normal low risk facilities for flooding, fault hazard zones, liquefaction, landslides, and aviation safety areas, no land use compatibility matrix has been identified for these facilities in the very high fire severity zone. County has adopted a detailed fire safety review overlay district and associated regulations to guide the development and maintenance of land. County follows minimum standards from the State Code to protect from wildfire hazards. No amendments have been made to the County's codes, although SBCFD follows regulations not currently codified by ordinance or resolution. The County attempted to achieve certification from the Board of Forestry and Fire Protection for its fire safety regulations (pursuant to Public Resources Code 4290 and 4291) but was denied due to inconsistencies with state law.	In accordance with amendments to California Government Code Section 65302, the County may wish to create a land use compatibility matrix and supporting policies that provide guidance in locating, when feasible, new essential public facilities outside of high fire risk areas. This could include, but may not be limited to hospitals and health care facilities, emergency shelters, emergency command centers, and emergency communications facilities, or identifying construction methods or other methods to minimize damage if these facilities are in a very high fire hazard severity zone. The County may wish to codify (locally adopt) the various regulations used that govern fire prevention measures (land use, building, site design, maintenance, etc.) or adopt a general plan policy that recognizes the various regulations used so as to achieve state certification for the County's Fire Safe Regulations. Conduct a study to review and, if appropriate, revise fire safe regulations that are inconsistent with state law. Changes should mirror state requirements or be shown to have the same practical effect as state requirements.
Other Observations	The County does not maintain a comprehensive fire safety master plan that details service levels, response time standards, evacuation routes, and other operational criteria. It is unclear whether NFPA standards are being followed.	Given the many fire service annexations processed through SBLAFCO over the last decade, the County could conduct a standards of coverage study and draft a countywide master plan for fire services that delineates fire service goals, policies, standards, and programs.

1.3.5 EMERGENCY PREPAREDNESS

The San Bernardino County Fire Department is an all-risk/full-service fire department. It serves as the designated hazards agency responsible for emergency preparedness in the County. In accordance with that responsibility, the County's state of readiness is articulated in the Emergency Operations Plan, Hazard Mitigation Plan, and other support plans. Table 1-5 lists emergency preparedness hazards and specific issues and opportunities to address them.

Table 1-5. Emergency Preparedness

Emergency Preparedness	Hazard Assessment Emergency preparedness continues to be a significant issue in San Bernardino County. Since 2000, the County has had 16 FEMA-declared disasters and numerous wildfires, resulting in 84 activations of the emergency operations center. Emergencies have been declared for severe weather, wildfires, floods, earthquakes, hazardous materials, high winds, power outages, water contamination, H1N1 flu epidemic, bark beetle, and terrorism. The Emergency Operations Plan governs response to these events. The Hazard Mitigation Plan assesses each hazard and proposes programs to prevent disasters and/or mitigate the impacts to people, property, and the environment.	
	Issues	Opportunities to Consider
Ambulance Service	County has adopted exclusive operating areas (EOAs) and granted sole jurisdiction to different ambulance transport companies to provide service within a specified area. Although authorized by state law, questions have arisen about the desirability to allow for these arrangements.	County is considering revisiting EOA boundaries and contracts terms for many of the agreements. A range of alternative service delivery options will be considered during the process.
Critical Facilities	The County includes an extensive inventory (thousands) of critical facilities and other facilities vulnerable to damage or destruction during a natural or manmade event. Many of these facilities may not meet optimal safety standards. However, they fall under the jurisdiction of other agencies.	Work with OSHPD, school districts, Caltrans, California Department of Water Resources, and other entities to encourage the retrofit and rehabilitation of critical facilities. This includes schools, hospitals, bridges and roads, dams, etc. Work with DWR to enforce provisions of state law requiring completion and submittal of emergency action plans for dams that present significant hazards.
Public Safety Service Standards	With the exception of ambulance transport, County public safety operations such as sheriff and fire agencies appear to not have established response times or standards of coverage studies. This makes it difficult to monitor performance or plan for service expansions as population increases.	Work with County agencies and LAFCO to determine appropriate service standards when consolidations and annexations are sought by cities, developers, or residents Fund service coverage studies to inform the county regarding the appropriate manpower, equipment, facilities, and response times desired by community
Hazard Mitigation	The County has recently updated its hazard mitigation plan and included a range of activities, programs and capital projects to complete. These items and policies need to be integrated into the countywide plan.	Develop element-specific implementation plans to meet the "feasible implementation" requirements of safety element requirements of Section 65302 of the Government Code.

1.4 ADDITIONAL ISSUES TO EXPLORE

Public safety covers far-reaching topics, and some are beyond the scope of this background report. The County may wish to further explore additional safety topics through the hazard mitigation plan, Countywide Policy Plan, or other planning efforts. Topics are summarized below.

1. Introduction

Resiliency and Climate Change

Upon the next revision of a local hazard mitigation plan on or after January 1, 2017, SB 379 requires the safety element to be reviewed and updated to address climate adaptation and resiliency strategies applicable to that city or county. The update must include a set of goals, policies, and objectives based on a vulnerability assessment; the risks that climate change poses to the local jurisdiction; the geographic areas at risk from climate change impacts; and specified information from federal, state, regional, and local agencies. While this requirement is addressed in the Hazard Mitigation Plan to meet federal requirements, a separate technical report is being prepared to address state requirements.

Environmental Justice and Disadvantaged Communities

Upon the revision of two or more general plan elements concurrently on or after January 1, 2018, SB 1000 requires a general plan environmental justice element, or related goals, policies, and objectives integrated in other elements. This bill requires the County to identify disadvantaged communities within the unincorporated County, ways to reduce the unique or compounded health risks in such communities, and ways to promote civil engagement in the public decision-making process. This bill also requires the County to prioritize improvements and programs to address the needs of disadvantaged communities. A separate technical report will be prepared to address this requirement.

Abandoned Mines

San Bernardino County has one of the largest inventories of abandoned mines in California, with abandoned mines scattered throughout rural communities, preserves, and even populated areas. Abandoned mine lands include lands, waters, and surrounding watersheds contaminated or scarred by the extraction, beneficiation, or processing of coal, ores, and minerals. These mines present environmental and physical safety hazards. According to the California Division of Mines' Abandoned Mines Program, an estimated five mines present moderate environmental safety risks, 50 mines present moderate to significant physical hazards, and 10 mines are ranked in the 100 most hazardous mines.

2. SEISMIC AND GEOLOGIC HAZARDS

This chapter addresses five topics: 1) introduction to seismic and geologic hazards; 2) governmental regulations that address these hazards; 3) inventory of geologic and seismic hazards and events in San Bernardino County; 4) mapping of hazards; and 5) organizations responsible for addressing them.

2.1 INTRODUCTION

San Bernardino County's varied topography has been shaped by historical seismic and geologic forces. The county is traversed by more than 80 active and potentially active faults that can cause damaging earthquakes. The US Geological Survey projects that the Southern California region has a 75 to 99 percent chance of being subject to earthquakes capable of producing significant damage in the next 30 years (source: https://pubs.usgs.gov/fs/2015/3009/pdf/fs2015-3009.pdf).

Geologic and seismic hazards in Yucaipa include erosion, earthquake faults, subsidence, and landslides.

Geologic and seismic hazards in Yucaipa include erosion, earthquake faults, subsidence, and landslides.

San Bernardino County is also subject to non-seismic geologic hazards–landslides, subsidence, corrosive soils, and other hazards in the mountains, valleys and deserts. Understanding these seismic and geologic hazards is a key step in informing the policies and implementation programs for the update of the Countywide Plan.

This chapter provides a discussion of the seismic and geologic hazards that may lead to the loss of life, bodily injury, property damage, litigation, impacts to lifelines and infrastructure, and disruption to commerce. While some hazards are countywide, other hazards are more localized.

This chapter references literature, aerial imagery, and mapping where available to identify, evaluate, and understand geologic and seismic hazards. Sources reviewed include geological and geotechnical reports and hazard maps produced for local, state, and federal government agencies. Sources include, but are not limited to the: County Geologist, California Geological Survey, Southern California Earthquake Center, California Office of Statewide Health Planning and Development, California Department of Housing and Community Development, California Department of Water Resources, US Geological Survey, National Oceanic and Atmospheric Administration, National Earthquake Information Center, and the California Institute of Technology. No geologic fieldwork was performed.

2. Seismic and Geologic Hazards

2.1.1 REGULATORY SETTING

The following federal, state, and local laws, regulations, and policies are pertinent to the geologic and seismic safety component of the Countywide Plan and Environmental Impact Report.

California Laws and Regulations

Alquist-Priolo Earthquake Fault Zoning Act (AP Act) of 1972

The AP Act addresses surface fault rupture that could damage structures and infrastructure (PRC Section 2621 et seq.). The act requires the State Geologist to delineate "earthquake fault zones" along faults that are deemed to be "recent," "sufficiently active," and/or "well defined." Earthquake fault zone maps are distributed to local agencies for use in planning and regulating the construction of structures and infrastructure. The act requires that local governments withhold development permits for sites in an earthquake fault zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from faulting. Generally, most structures for human occupancy must be set back 50 feet from an active fault. The County follows this general standard, but requires a minimum setback of 150 feet for critical facilities. The County may require a greater setback from poorly defined faulting or complex faulting. Additional info can be found by visiting www.conservation.ca.gov/cgs/rghm/ap.

Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act (SHMA) addresses earthquake hazards other than surface rupture, including ground shaking, liquefaction, and seismically induced landslides (PRC Section 2690 et seq.). The California Geological Survey (CGS) prepares seismic hazard zone maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. These maps are provided to local government to assist in planning, land use, and development decisions. When projects are proposed within "zones of required investigation, site-specific geological technical reports must be prepared and submitted to the State Geologist within 30 days of its approval. However, the County may establish policies and criteria more restrictive than state law. Seismic hazard zone maps are gradually being released for areas throughout California and can be accessed at: (http://gmw.consrv.ca.gov/shmp/html/pdf_maps_so.html).

Real Estate Disclosure Requirements

The Natural Hazards Disclosure Act requires sellers (and their real estate agents) to disclose to prospective buyers that property being sold is in an earthquake fault zone or seismic hazard zone. Disclosure can be achieved in one of two ways: 1) the Natural Hazards Disclosure Statement; or 2) the Local Option Real Estate Disclosure Statement as provided in Section 1102.6 of the California Civil Code. When houses built before 1960 are sold, the seller must also give the buyer an earthquake hazards disclosure report and a copy of "The Homeowner's Guide to Earthquake Safety" (www.seismic.ca.gov/pub/cssc_2005-01_HOG.pdf) to inform the buyer of potential hazards and ways to address them. However, it is important to note that the Natural Hazards Disclosure Act does not invalidate a property sale based on a failure to comply with the above requirements. Therefore,

prospective homebuyers should ensure that real estate disclosures requirements are adhered to during the purchase process.

Government Codes Affecting Specific Building Types

This section highlights certain buildings, structures, and infrastructure in San Bernardino County that are particularly vulnerable to seismic hazards and the key state laws and regulations affecting them.

Mobile Homes

Mobile homes are prefabricated homes placed on piers, jackstands, or masonry block foundations. Floors and roofs are usually plywood and outside surfaces are covered with sheet metal. Severe damage can occur when mobile homes fall off their supports, severing utility lines and piercing the floor with jack stands. State law governing mobile homes and special occupancy parks can be found in the "Mobilehome Parks Act" and the "Special Occupancy Parks Act" (Health and Safety Code). In 2011, regulations were adopted that address park construction, maintenance, use, occupancy, and design. However, the amendments do not require earthquake-resistant bracing systems. Because the county has more than 44,000 mobile homes (many of which are occupied by seniors), and mobile homes generally fare poorly in earthquakes, ensuring the safety of mobile home occupants is critical. There is little to no information about the seismic safety of existing mobile home parks in the county.

Acute Care Hospitals

The Alquist Hospital Seismic Safety Act established enhanced seismic building standards for hospitals. Following the 1994 Northridge Earthquake, which resulted in $3 billion damage to hospitals, the act was amended by SB 1953 to improve hospital safety. Hospitals are rated from 1 to 5 in structural performance categories (SPC). Many acute hospitals have a SPC-1 rating and are at risk of collapse during a major earthquake. Facilities rated SPC 2 will sustain heavy damage but remain operable. Each general acute care hospital facility must attain an SPC-3 rating by 2030, or be subject to closure. As of 2016, only 7 of the 21 acute-care hospitals in the county have achieved the required SPC ratings for structural portions of occupied buildings, although unoccupied portions may still be at risk. Many of the hospitals also do not meet seismic safety standards for nonstructural portions as well. Although state-owned hospitals are exempt from this requirement, the California Building Standards Commission has adopted regulations applicable to seismic evaluations and retrofits for such hospitals.

Concrete Buildings

Nonductile or tilt-up concrete buildings performed poorly in the 1971 San Fernando earthquake and the 1987 Whittier earthquake. Partial or total collapse of buildings where the floors, walls, and roofs failed as intact units caused the greatest loss of life and damages. Concrete tilt-up buildings have concrete wall panels, often cast on the ground or fabricated off-site, that are tilted upward to their final position. If connections between the walls and roofs are weak, they can separate during earthquakes, causing floors or roofs to collapse. Concrete buildings pose a significant safety concern in the county. The 2011 Hazard Mitigation Plan identified thousands of concrete and precast concrete structures in the unincorporated areas and incorporated cities. Most jurisdictions do not have retrofit provisions for

vulnerable concrete buildings. Given that many concrete industrial buildings include businesses that generate and store hazardous materials, the threat to public safety is significant.

School Buildings

School buildings have long presented seismic safety concerns. Hundreds of school buildings are located throughout San Bernardino County. The Field Act of 1933 requires schools to meet the latest seismic safety standards, and the Division of the State Architect (DSA) oversees and approves all school construction projects. However, schools built before 1978 may not afford the same seismic safety protection. As part of the DSA's "AB300 list," 131 schools in San Bernardino County needed further evaluation to determine seismic risks, and 12 schools showed hazardous conditions. Moreover, the Field Act does not apply to private schools or charter schools, so additional buildings are likely at risk of failure or damage during an earthquake. Although funding has been available at the state level, the regulations have made it difficult to obtain. In short, school seismic safety remains an important issue for public, private, and charter schools for all communities in San Bernardino County.

Essential Facilities

Essential facilities include fire stations, police stations, emergency operations centers, California Highway Patrol offices, sheriff's offices, or emergency communication dispatch centers. California enacted the Essential Services Building Seismic Safety Act of 1986, which required the DSA to promote regulations, review, and approve construction plans for certain essential facilities. The law applies to the retrofit of state-owned and leased buildings, but it does not require retrofits of local essential buildings built before 1986. San Bernardino County has approximately 1,500 buildings considered "essential facilities." According to the 2010 County Local Hazard Mitigation Plan, an M 6.7 earthquake along the San Jacinto or Puente Hills faults would damage hundreds of essential facilities. This level of damage would significantly impair response and recovery from natural disasters.

Lifeline Infrastructure

Lifeline infrastructure refers to any continuously engineered system providing transportation, communication, water, power, or other distributed services. This includes electrical utilities, pipelines, water supplies, wastewater treatment systems, dams/reservoirs/flood control, solid waste disposal systems, transportation systems, and other similar systems. These lifeline facilities and infrastructure are susceptible to primary and secondary earthquake hazards. Each of these infrastructure components is regulated by a variety of different agencies and state laws. However, in the event of an earthquake, the consequences could be significant if any of this infrastructure is damaged.

After the 1971 Sylmar earthquake, Caltrans completed a seismic retrofit program to strengthen state-owned bridges. However, local bridges remain a concern. According to the US Department of Transportation, 217 of the county's 1,379 bridges are structurally deficient or functionally obsolete. There is no equivalent survey of railroad bridges, although the California Public Utilities Commission began an inventory in FY2013-2014. Data are not available regarding whether these bridges meet fire safety standards or can support military equipment. Following the 1989 Loma Prieta earthquake,

Caltrans initiated the Local Bridge Seismic Safety Retrofit Program to assist in improving local public bridges; as of 2014, 24 bridges in San Bernardino County are programmed for rehabilitation.

Key Local Codes and Regulations

General Plan Policy

The General Plan (Safety Element) includes land use compatibility charts that County staff must follow when considering and reviewing applications for siting certain types of land uses in areas with known or potentially known seismic or geologic hazards. Table 2-1 presents a rating of the compatibility of specific land uses with seismic or geologic hazards.

Table 2-1. Compatibility of Land Uses in Areas with Seismic and Geologic Hazards

Seismic or Geologic Hazard	Types of Land Use Facilities			
	Critical	Essential	High Occupancy	Normal to Low Risk
Landslide Susceptibility Zones				
+ Least Susceptible	Most Compatible	Most Compatible	Most Compatible	Most Compatible
+ Marginally Susceptible	Marginally Compatible	Marginally Compatible	Generally Compatible	Generally Compatible
+ Generally Susceptible	Least Compatible	Least Compatible	Marginally Compatible	Marginally Compatible
+ Most Susceptible	Least Compatible	Least Compatible	Least Compatible	Least Compatible
Liquefaction Potential Zones				
+ Medium Zone	Generally Unsuitable	Generally Unsuitable	Provisionally Suitable	Provisionally Suitable
+ Medium-High Zone	Restricted	Restricted	Generally Unsuitable	Generally Unsuitable
+ High Zone	Restricted	Restricted	Restricted	Restricted
Fault Hazard Zone				
Faults	Restricted	Restricted	Provisionally Suitable	Provisionally Suitable

Source: 2007 San Bernardino County General Plan

Notes:

COMPATIBILITY:

Restricted: Restricted unless alternative sites are unavailable or feasible and hazards can be adequately mitigated (may be costly).

Generally unsuitable: Restricted unless site investigation demonstrates that the site is suitable or that hazards will be adequately mitigated.

Provisionally suitable: Requires site investigation to confirm suitability; may require some modification of facility design or siting.

FACILITY TYPES:

Critical: Includes nuclear related systems, explosives or hazardous materials/manufacturing; handling or storage; hospitals and other emergency medical facilities.

Essential: Police, fire, and communication systems; various water, sewer, and power utilities; gas and electric distribution lines; major pipelines, major roadways, bridges, and other transportation infrastructure; public assembly sites and schools, etc.

High occupancy: Multiple-family residential of 20 units or more; major commercial land uses including shopping centers, office buildings, large hotels, health care clinics and rest homes/nursing homes; heavy industry; gas stations

Normal to low risk: Single family, two-family residential uses; multiple-family residential uses of less than 20 units; small scale commercial; small hotels, motels; light industry and warehousing

County General Plan policies require that decisions for permitting any application for development should consider both facility siting requirements and the compatibility with adjacent or nearby uses. These policies are found within the Safety Element of the General Plan. Moreover, certain facilities (e.g., pipelines, utilities, etc.) may involve state and federal authorities or laws that preempt local control. Applicable policies addressing land use compatibility are implemented through specific development, siting, building, and/or other regulations in the GH overlay district.

2. Seismic and Geologic Hazards

Geologic Hazard Overlay District

The Geologic Hazard (GH) Overlay established by the General Plan and the Development Code (§82.01.020, 82.01.030) establish investigation requirements in areas subject to seismic and geologic hazards. These include active faulting, landsliding, debris flow/mud flow, rockfall, liquefaction, seiche, subsidence/inflation, volcanism, and adverse soil conditions. Within the GH Overlays Zone, the development code requires a detailed geologic study prepared by a California Professional Geologist to be submitted with all land use applications and development permits proposed within the GH overlay. Should a GH overlay apply, development and land uses proposed on a site shall comply with the following standards.

- Structures used for human occupancy shall be located at least 50 feet from all active earthquake fault traces, unless lesser setbacks are applicable as determined by geologic investigations as required by the GH overlay and approved by the County geologist.
- Critical facilities shall be located at least 150 feet from active earthquake fault traces. These include dams (DSOD), reservoirs, fuel storage, power plants, nuclear reactors, police and fire stations, schools (OSA), hospitals (OSHPD), rest homes/nursing homes, and emergency communication sites.
- Utility lines and streets shall not be placed within the construction setback of a hazardous fault except for crossing perpendicular to the fault trace or as recommended by the project geologist and approved by the County geologist.
- Use of development-restricted areas as recreation and common open spaces is encouraged as mitigation to the geologic hazards overlay.

San Bernardino County Building Code

The California Buildings Standards Code (California Code of Regulations, Title 24) is a compilation of codes and standards for electrical, mechanical, plumbing, fire, design, and other structural features. The CBC is updated every three years with the latest advances in building technology and practices recommended by the International Code Council. Every local government is required by state law to adopt the California Building Code (CBC) within 180 days of publication. San Bernardino County has adopted the most recent 2016 update of the CBC. The 2016 triennial update to the CBC is being released and will be considered for adoption by the County.

State law permits jurisdictions to amend state building codes to address local geographic, topographic, or climatic conditions. For example, certain jurisdictions have adopted standards for soft-story buildings (Los Angeles), bracing requirements, ceiling suspension load (Long Beach), etc. The California Building Commission publishes all code amendments adopted by local agencies. The County amended the 2016 CBC for administrative provisions and included excavation and grading requirements that were not in the original 2016 CBC. No other local amendments were made, although other cities in the county may have adopted more restrictive amendments.

2.1.2 IMPORTANT TERMS

The following are important terms for understanding seismic and geologic hazards in this section.

Earthquake Strength

The Richter Scale and Modified Mercalli Intensity Scale describe the effects of an earthquake. The Richter scale measures the magnitude on a logarithmic scale. Each one-point increase in magnitude (M) represents a tenfold increase in earthquake wavesize and a 30-times increase in energy release (strength). For example, an M8 earthquake produces 10 times the ground motion amplitude of an M7 earthquake, 100 times that of an M6 quake, and 1,000 times the motion of a magnitude 5. However, the M8 earthquake is 27,000 times stronger than an M5 quake. The Modified Mercalli Intensity Scale measures the intensity of an earthquake based on its effect on structures, the environment, and the earth's surface at a certain location. Table 2-2 compares and describes both scales.

Table 2-2. Measures of Earthquake Strength

Mercalli Scale	Richter Scale	Intensity of Shaking	Description/Damage
I	1 to 3	Not felt	Not felt except by a very few under especially favorable conditions.
II	2	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	3	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
IV	4	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	4 to 5	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	5	Strong	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	5 to 6	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures.
VIII	6 to 7	Severe	Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls is possible.
IX	6 to 7	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	7 to 8	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	8	Extreme	Few, if any, masonry structures remain standing. Bridges destroyed. Underground pipelines completely out of service. Rails bent greatly.
XII	8+	Extreme	Damage is total. Lines of sight and level are distorted. Objects thrown into the air.

Source: USGS, Magnitude/Intensity Comparison, 2016. https://earthquake.usgs.gov/learn/topics/mag_vs_int.php

2. Seismic and Geologic Hazards

Expansive Soils

Expansive soils are characterized by their ability to shrink or swell due to variations in moisture content. Expansive soils expand when water is added and contract when the soils dry. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, pool leakage, roof drainage, perched groundwater, drought, or other factors. As a result of volume changes, expansive soils can lead to structural damage to buildings, infrastructure, and pavement if the potentially expansive soils were not considered or mitigated during the design and construction of a project.

Fault

A fault is a break in the rocks that make up the Earth's crust, along which rocks on either side have moved past each other. Faults are classified in three ways. The CGS defines a potentially active fault as one that shows evidence of movement within the last 2.6 million years (Pleistocene time), but does not show conclusive evidence that it has ruptured in the past 11,000 years. The USGS considers a fault potentially active if it has moved in the time period between 11,000 years ago (Holocene) and 750,000 years ago (late Pleistocene), and if it is thought to be capable of generating a damaging earthquake.

Surface Fault Rupture

Surface fault rupture is displacement that occurs along the ground surface of an active fault, primarily as the result of an earthquake. A fault is a fracture or zone of closely associated fractures along which earth materials on one side have been displaced with respect to those on the other side. When an earthquake occurs, ground surface rupture can result in vertical and/or horizontal displacement of the surface. Triggered surface fault rupture occurs when a large earthquake on one fault causes nearby active faults to rupture the ground surface due to strong shaking. In addition, secondary fault rupture refers to ground surface displacements along faults other than the main traces of active regional faults.

Ground Shaking

Ground shaking is the movement of the earth's surface as a result of an earthquake. Ground motion produced by seismic waves emanate from slow or sudden slip on a fault. The degree of ground shaking felt at a given site depends on the distance from the earthquake source, the magnitude of the earthquake, the type of subsurface material on which the site is situated, and topography. Generally, ground shaking is less severe on rock than on alluvium or fill, but other local phenomena may override this generalization. Ground shaking can produce significant ground horizontal and vertical movement that can result in severe damage to structures that are generally not equipped to withstand it.

Landslides

Landslide is a general term for the downslope movement of masses of soil and rock material. Landslides that have occurred in the county include "slides," "slumps," "falls," "topples," "avalanches," and "debris flows." A slide is a downslope movement of a soil or rock mass. A slump is when a mass of loosely consolidated soil and/or rock moves a short distance down a slope. A fall is a rapid vertical detachment of soil or rock from a steep slope along a surface on which little or no shear displacement takes place. A topple is the forward rotation of a mass of soil or rock off of a steep slope.

A flow is a mass movement of unconsolidated material in a plastic or semifluid state. An avalanche is when a mass of soil and/or rock moves rapidly down a slope. A debris flow is when a water-laden mass of rock fragments, soil, and mud moves rapidly downslope and typically occurs following prolonged or heavy rainfall, or on hillsides that have limited vegetation, such as after a brushfire. Mudflow is a related concept defined in the next chapter on flooding. Although included here, mud/debris flows are addressed more fully in the chapter on flooding hazards.

Liquefaction and Lateral Spreading

Liquefaction is a condition where ground shaking causes sandy soils saturated with water to become fluid-like, which can lead to ground surface deformation. Liquefaction generally occurs at depths of less than 50 feet in soils that are young (Holocene age), saturated, and loose. Soils that are most susceptible to liquefaction are clay-free deposits of sands and silts, and unconsolidated alluvium. Lateral spreading, a hazard associated with liquefaction, is the finite, lateral movement of gently to steeply sloping, saturated soil deposits caused by earthquake-induced liquefaction.

Subsidence

Subsidence is the permanent collapse of the pore space within a soil or rock and downward settling of the earth's surface relative to its surrounding area. Subsidence can result from the extraction of water or oil, or the addition of water to the land surface—a condition called "hydrocompaction." The compaction of subsurface sediment caused by the withdrawal or addition of fluids can cause subsidence. Land subsidence can disrupt surface drainage; reduce aquifer storage; cause earth fissures, damage buildings and structures; and damage wells, roads, and utility infrastructure.

Seismic Settlement and Differential Settlement

Seismic settlement is the lowering of the ground surface as a result of strong, earthquake-induced shaking and liquefaction. Differential seismic settlement occurs when ground shaking causes one type of soil or rock to settle more than another type. This often occurs on sandy soils and alluvium that have low cohesive strength. Damage can occur if buildings have been built on low-strength soils and imported fill or if such improvements straddle different types of subsurface materials with different load-bearing capacities. Although differential settlement generally occurs so slowly that its effects do not endanger occupants, it can cause significant damage to buildings and infrastructure over time.

Soil Corrosivity

Soil corrosivity refers to a certain classification of soils containing chemical properties that react with construction materials and that may damage foundations and buried pipelines. Corrosive soils have high contents of chloride, sodium, or sulfate minerals. Soils with high amounts of sulfate minerals, such as gypsum, are harmful to concrete, particularly in acidic soil (low pH). High chloride concentrations from saline minerals can corrode metals (carbon steel, zinc, aluminum, and copper). Low pH and/or low resistivity soils can also corrode buried or partially buried metal structures.

2.1.3 GEOLOGIC SETTING

This section on geologic setting briefly describes the geology, geomorphology, and faults of the County's three regions–Valley, Mountains, and Desert regions.

Valley Region

The Valley Region sits at the base of the San Bernardino mountains. The Valley Region is an area of low relief, consisting predominantly of alluvial fans and plains that range from 500 to 3,500 feet above mean sea level (amsl). Beneath the surface, the Valley Region consists of deep alluvial-filled basins that receive sediment from the adjacent San Gabriel and San Bernardino mountains. Groundwater depths in the Valley Region can range from very shallow to relatively deep. Although smaller in area than either the Desert or Mountain regions, the Valley Region is the major population center of the county and is, therefore, most susceptible to loss of life and structural damage during an earthquake. The San Andreas, San Jacinto, Chino-Central Avenue, Cucamonga, Puente Hills, and other local prominent faults cross or are close to the Valley Region and can cause earthquakes of significant magnitude.

Mountain Region

The Mountain Region encompasses the San Bernardino Mountains and eastern San Gabriel Mountains. The Mountain Region is part of the east-west trending Transverse Range geomorphic province of California and consists of steep mountainous terrain. Multiple peaks exceed 10,000 feet amsl, with the highest peak, Mount San Gorgonio, topping out at an elevation of 11,500 feet amsl. The mountain flanks are typically steep sided and deeply dissected by stream canyons. Most of the mountain areas consist of Mesozoic granitic rocks and Precambrian metamorphic rocks, which are typically overlain by thin ribbons of alluvium in the canyon bottoms. Alluvial valleys (including Bear Valley and Swarthout) are in the Mountain Region. The San Andreas, San Jacinto, and Cucamonga faults are prominent faults that cross or are located near the Mountain Region.

Desert Region

The Desert Region comprises most of the Mojave Desert and parts of the Basin and Range geomorphic provinces of California. The Desert Region generally lies between 2,000 and 5,000 feet amsl and is characterized by mountain ranges and hills of moderate relief that are partially buried and separated by broad alluvial basins. Mountain ranges and hills primarily consist of Mesozoic granitic and Mesozoic to Precambrian metamorphic rocks. Cenozoic sedimentary and volcanic rocks and landforms are also common. For example, basaltic lava flows and volcanic cinder cones near Pisgah and Amboy and the sedimentary Barstow formation in the Rainbow Basin are prominent features. Prominent active faults in the Desert Region include, among others, the San Andreas, Garlock, Kickapoo/Landers, Camp Rock-Emerson, Copper Mountain, Calico, Helendale, Lenwood, Lockhart, Mesquite Lake, Bullion, Lavic Lake, Manix, North Frontal, Sky High Ranch, and Pinto Mountain.

Generalized geologic maps are available online through the California Department of Conservation (http://maps.conservation.ca.gov/cgs/gmc/).

2.1.4 RECENT GEOLOGIC AND SEISMIC EVENTS

San Bernardino County is frequently subject to earthquakes; hundreds of earthquakes occur each year. Typically, earthquakes do not cause significant damage unless a certain magnitude (M) is achieved. Table 2-3 lists the most damaging earthquakes in the last 200 years.

Table 2-3. Summary of Earthquakes Approximately M 5.0 or Greater in San Bernardino County

Location and Date	Fault and Magnitude	Description
1812 Wrightwood Earthquake Date: 12/08/1812	San Andreas Fault M 7.5	An estimated M 7.5 earthquake struck along the San Jacinto - San Andreas fault in the Wrightwood area. The earthquake resulted in as much as 105 miles of surface rupture and caused 40 fatalities at the San Juan Capistrano Mission. who were killed when the church walls collapsed.
1857 Fort Tejon (Mountain Region) Date: 01/09/1857	San Andreas Fault M 8.0	One of the greatest earthquakes ever recorded in the United States produced a surface rupture of 217 miles along the San Andreas fault from Cholame to the Cajon Pass area. The M 7.9 quake produced an average slip of 15 feet. Strong ground shaking was reported for to have lasted from one to three minutes. Only one life was lost, likely due to the sparse population of southern California at the time.
1899 Cajon Pass (Mountain and Valley) Date: 07/22/1899	Fault uncertain M 5.7	An estimated M 5.7 earthquake struck on an unknown fault somewhere near Lytle Creek and the Cajon Pass area of the county. The earthquake triggered landslides that blocked Lytle Creek Canyon Road and the road through Cajon Pass. Damage to buildings was reported in San Bernardino, Highland, and Patton. No deaths were reported.
1923 Loma Linda (Valley Region) Date: 07/22/1923	San Jacinto Fault M 6.3	An estimated M 6.3 earthquake struck on the San Jacinto fault, 7 miles south of San Bernardino. Damage, consisting primarily of downed chimneys, cracked walls, and broken windows, was greatest in San Bernardino and Redlands. Buildings that sustained significant damage were generally poorly constructed. Only two people were critically injured, but no one was killed.
1947 Fort Irwin (Desert Region) Date: 04/10/1947	Manix Fault M 6.5	An estimated M 6.5 earthquake struck on the Manix fault, approximately 25 miles east of Barstow, near Fort Irwin. The surface rupture was about 3 miles long and the maximum slip was about 5 centimeters. It caused relatively little damage in this sparsely populated area. The earthquake caused cracking of concrete floors, cracked walls, and caused a few structures to collapse.
1970 Lytle Creek (Mountain and Valley) Date: 09/12/1970	Fault uncertain M 5.2	An M 5.2 earthquake struck in the Lytle Creek area. The earthquake caused landslides and rock falls in the mountains that blocked several roads. Minor damage occurred in the Lytle Creek area and in the nearby communities of Colton, Crestline, Cucamonga, Fontana, Glendora, Highland, Mt. Baldy, Rialto, Rubidoux, and Wrightwood. No deaths were reported.
1975 Galway Lake (Desert Region) Date: 05/31/1975	Galway Lake Fault M 5.0	An estimated M 5.0 earthquake struck on the Galway Lake fault, about 36 miles southeast of Barstow. Due to its remote location and its moderate magnitude, the earthquake caused minor damage. The earthquake caused a surface rupture of about 4 miles, with a maximum surface displacement of 1.5 centimeters, along the previously unmapped fault.
1979 Homestead Valley (Desert Region) Date: 03/15/1979	Homestead Valley Fault M 5.3	An estimated M 5.3 earthquake produced about 2 miles of surface rupture on the Homestead Valley fault in the Desert Region. The maximum surface rupture offset was about 4 inches (10 centimeters). The event included at least 24 earthquakes within one day of the initial earthquake. The Homestead Valley fault ruptured along most of its length during the 1992 Landers earthquake.
1988 Upland (Valley Region) Date: 06/26/1988	San Jose Fault M 4.7	An estimated M 4.7 earthquake struck along the San Jose fault, about 2 miles northwest of Upland. The 1988 Upland earthquake caused minor damage in the epicentral area and would have been of relatively little note were it not for the possibility that it may have been triggered by the Whittier Narrows earthquake.

2. Seismic and Geologic Hazards

Table 2-3. Summary of Earthquakes Approximately M 5.0 or Greater in San Bernardino County

Location and Date	Fault and Magnitude	Description
1990 Upland (Valley Region) Date: 02/28/1990	San Jose Fault M 5.5	Two years later, an M 5.5 earthquake struck along the San Jose fault. This earthquake triggered landsliding, which blocked roads in the Mount Baldy area, and some damage to the San Antonio dam. Thirty-eight people sustained minor injuries, and damage was considerable near the epicenter.
1992 Joshua Tree (Desert Region) Date: 04/22/1992	Eureka Peak Fault M 6.1	An M 6.1 earthquake struck about 11 miles east of Desert Hot Springs. Damage was slight to moderate in Joshua Tree, Yucca Valley, Desert Hot Springs, Palm Springs, and 29 Palms. Thirty-two people sustained minor injuries. Aftershocks suggested that the causative fault was a northwest-trending, right-lateral strike-slip fault, possibly the Eureka Peak fault.
1992 Landers (Desert Region) Date: 06/28/1992	Johnson Valley, Landers, Homestead, Emerson, and Camp Rock faults M 7.3	The M 7.3 Landers quake struck near Yucca Valley, producing a 53-mile long surface rupture of 10 to 13 feet with a maximum slip of 20 feet. Collectively the quakes caused one death, over 400 injuries, and more than $120 million in non–inflation adjusted damage to property, roads, and water systems. There were 18 aftershocks near Landers and Big Bear greater than magnitude 5.0.
1992 Big Bear (Mountain Region) Date: 06/28/1992)	Johnson Valley, Kickapoo, Landers, Homestead, Emerson, and Camp Rock, Burnt Mountain, and Eureka Peak faults M 6.4	The M 6.4 Big Bear earthquake was technically an aftershock of the Landers earthquake, but did not produce a surface rupture that could be located. The earthquake occurred at a relatively shallow depth of 5 kilometers (3.1 miles) and caused landslides in the San Bernardino Mountains and millions of dollars of damage to homes and infrastructure.
1992 Mojave (Desert Region) Date: 07/11/1992	Garlock Fault M 5.7	The M 5.7 Mojave earthquake was triggered by movement along the Garlock Fault, potentially in response to the Landers earthquake. Limited information is known on its impact due to the remoteness of the location.
1997 Calico (Desert Region) Date: 03/18/1997	Calico Fault M 5.3	An M 5.3 earthquake struck along the Calico fault, about 12 miles northeast of Barstow. This earthquake was the last aftershock of the Landers earthquake of 1992 to reach magnitude 5. The most significant damage occurred at the historic Calico Ghost Town Regional Park near Barstow. A "historic themed" passenger tram and several wood and adobe buildings were damaged.
1999 Hector Mine (Desert Region) Date: 10/16/1999	Lavic Lake Fault M 7.1	An M 7.1 earthquake struck about 34 miles northwest of Twentynine Palms and produced a 25-mile-long surface rupture along the Lavic Lake, Mesquite Lake, and Bullion faults. Maximum surface displacement was about 5 meters. Four aftershocks exceeded M 5.0. The earthquake toppled a freight train just north of the northern rupture terminus.
2003 Big Bear (Mountain Region) Date: 02/22/2003	Helendale Fault M 5.4	An M 5.4 earthquake struck 2 miles north of Big Bear City at a depth of 3.7 miles. It was not preceded by foreshocks. It was followed by strong aftershock activity, with 116 aftershocks during the first 6 hours. The 5 largest aftershocks ranging from M 4 to M 4.5. No injuries or fatalities.
2008 Chino Hills (Valley Region) Date: 07/29/2008	Whittier/Chino Hills Faults M 5.5	The M 5.5 Chino Hills earthquake struck in the Carbon Canyon area along the Puente Hills blind thrust fault. The earthquake did not cause any surface rupture, but was felt as far away as San Diego and Las Vegas. Only minor damage was reported, but reports were surprisingly widespread, from a small landslide along SR-91 freeway near Corona to a fire in an abandoned movie theater in Santa Ana.

Source: Southern California Earthquake Data Center, 2016.

The USGS encourages individuals to report earthquake shaking through the website "Did You Fell It?" at: (https://earthquake.usgs.gov/data/dyfi)

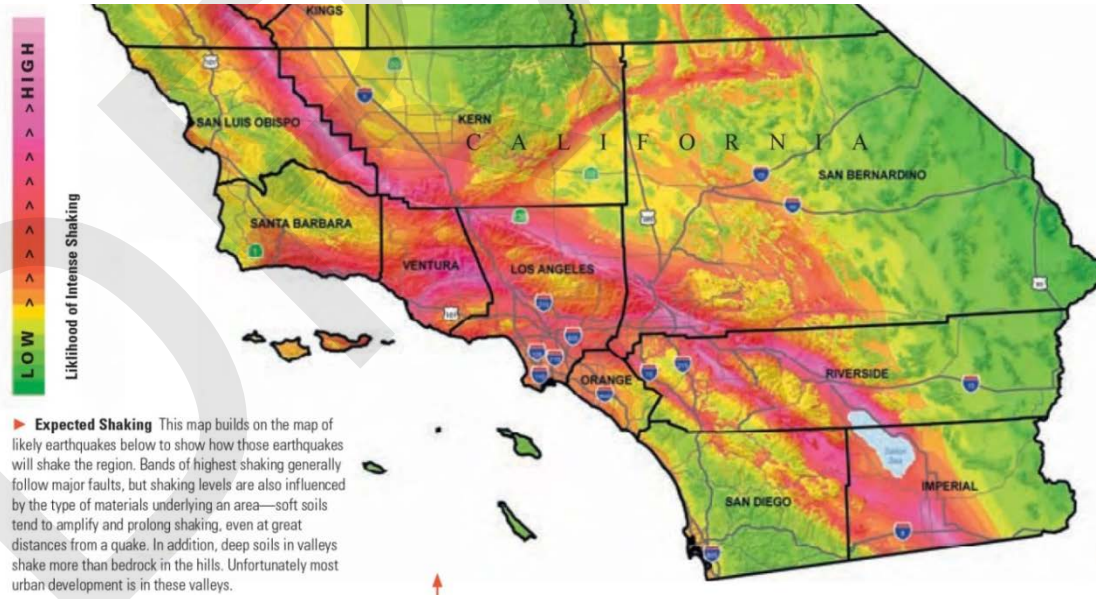
2.2 SEISMIC AND GEOLOGIC HAZARDS

This section discusses potential seismic hazards and identifies general areas within the county that could be impacted by these hazards. Primary seismic hazards include ground shaking, surface fault rupture, liquefaction, differential seismic settlement, and subsidence.

2.2.1 GROUND SHAKING

Ground shaking, defined as the displacement of the ground due to seismic waves from an earthquake, is responsible for the vast majority of damage. In general, the degree of shaking depends on: 1) the earthquake's size, location, and distance; 2) direction of seismic waves; and 3) site effects. Although identifying the exact area where the ground will shake is not possible, the CGS produced shake maps (illustrated below) that illustrate the where the intensity of ground shaking from earthquakes is expected to be most pronounced according to a number of probabilistic assumptions.

The Valley Region has the highest probability of ground shaking, specifically in San Bernardino, Devore, Fontana, Colton, Rialto, Loma Linda, and Redlands. Other likely places for ground shaking are Rancho Cucamonga-Upland, Yucaipa-Oak Glen, and Chino Hills. In the Mountain Region, Wrightwood straddles the San Andreas Fault and is most likely to experience strong ground shaking, followed by Big Bear Lake. In the Desert, likely places for ground shaking (in order of declining probability) include Hesperia-Phelan, Death Valley, Morongo Valley, Twentynine Palms, High Desert, Landers, Lucerne Valley, and Barstow-Yermo-Newberry Springs.



Probabilistic ground shaking maps under a variety of assumptions are available for regions across California and can be accessed through a large format map (PDF) or through a dynamic online map.

2.2.2 LATER QUATERNARY SURFACE FAULT RUPTURE

Surface fault rupture occurs when movement along a fault breaks through to the surface. It may occur suddenly during an earthquake or gradually over a long period of time in the form of fault creep. It commonly occurs with shallow earthquakes, those with an epicenter less than 20 kilometers deep. Primary ground rupture usually results in a relatively smaller percentage of the damages caused by a quake. Primary fault rupture is rarely confined to one fault; it often spreads out into complex patterns of secondary faulting (faults other than the main traces of active faults) and ground deformation. Movement along secondary faults generally occurs in response to a triggering event–such as movement on a nearby larger regional fault.

Surface fault rupture from the Landers Earthquake.
Source: USGS Photo Gallery

Surface fault rupture from the Landers Earthquake.
Source: USGS Photo Gallery

The potential for surface fault rupture along an active or potentially active fault or along secondary faults exists in all three regions of the county. Notable historical occurrences of fault rupture include:

- 1999 Hector Mine Earthquake. Surface ruptures extended for 31 miles, with displacements of up to six feet. Damage was minimal due to the remote location of the displacement.
- 1992 Landers Earthquake. Surface ruptures extended for 53 miles, with displacements ranging from one inch to 20 feet, damaging structures and offsetting roads around Landers.
- 1857 Fort Tejon Earthquake. Surface ruptures extended for 220 miles, from the Cajon Pass to Cholame; displacements averaged 15 feet with a maximum of 30 feet.

Areas of secondary fault rupture can also be a concern. Secondary faulting involves a web of interconnected faults that rupture in response to a primary rupture. Secondary ground deformation can include fracturing, shattering, warping, tilting, uplift, and/or subsidence. Such deformation may be relatively confined along the rupturing fault or spread over a large region (such as the regional uplift of the Santa Susana Mountains after the Northridge earthquake). Deformation and secondary faulting can also occur without primary ground rupture, as in the case of ground deformation above a blind (buried) thrust fault. The Cleghorn fault complex in southern Hesperia is an example of an area where secondary fault rupture and ground deformation would be expected to occur.

Figure 2-1 displays the Alquist-Priolo (AP) zones in San Bernardino County, which provide the closest approximation of surface fault rupture hazards. Additional information on Alquist-Priolo is at: (http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps).

Figure 2-1 Alquist-Priolo Zones and Fault Zones with Potential for Magnitude 5+ Earthquakes

2. Seismic and Geologic Hazards

This page left intentionally blank

Earthquake Faults Significant for San Bernardino County

San Bernardino County is crossed by more than 80 active and potentially active faults that could rupture and have the potential to produce moderate to large and potentially damaging earthquakes. Many of these faults are in remote, unpopulated area of the county, but other faults capable of generating moderate to large earthquakes are near major population centers. Only fault zones capable of producing earthquakes with a magnitude in excess of M 5 (typically capable of causing damage to structures and infrastructure) and which are dated later than the late Quaternary period are shown.

Table 2-4 identifies faults projected to have the potential for M 5 or greater earthquakes, along with a list of nearby communities and/or military facilities and historical earthquakes in San Bernardino County. Figure 2-1 illustrates the location of each fault zone listed below.

Table 2-4. Faults with Projected Potential for M 5+ Earthquakes

ID	Fault Zone Name	Maximum Probable Magnitude	Fault Period (Age)	Nearby Communities and/or Military Facilities	Historical Earthquakes
1	Arrastre Canyon Narrows	6.2	LTQT	Lucerne Valley	
2	Baker	5+	LTQT	Baker	
3	Blackwater	7.1	HOL	Barstow, Yermo	
4	Bowen Ranch	6.4	LTQT	Lucerne Valley	
5	Bullion Mountains	7.1	HOL	Landers	
6	Burnt Mountain	7.3	HIS	Yucca Valley, Morongo Valley, Joshua Tree	M 7.3 Landers 1992
7	Calico-Hidalgo	7.1	HIS	Newberry Springs	M 5.3 Calico 1997
8	Camp Rock-Emerson-Copper Mountain	7.5	HOL/LTQT	Daggett; Johnson Valley, Lucerne Valley	M 7.3 Landers 1992; M 5.0 Galway Lake 1975
9	Central Avenue	6.6	LTQT	Chino	
10	Chemehuevi Graben	5+	LTQT	Chemehuevi Indian Reservation	
11	Cleghorn	6.7	LTQT	Crestline, Lake Arrowhead	
12	Crafton Hills	6.4	HOL & LTQT	Mentone, Yucaipa	M 4.5 Crafton Hills 1998
13	Elsinore (Chino)	7.0	HOL	Chino, Chino Hills	
14	Eureka Peak	7.3	HOL/HIS	Joshua Tree, Yucca Valley	M 7.3 Landers 1992
15	Garlock	7.6	HOL	Fort Irwin, Naval Air Weapons Station China Lake	M 5.7 Garlock 1992
16	Harper	7.2	HOL/LTQT	Barstow, Daggett, Yermo	
17	Helendale-South Lockhart	7.3	HOL/LTQT	Edwards Air Force Base, Kramer Junction	
18	Homestead Valley	7.3	HIS	Landers	M 5.3 Homestead 1979
19	Johnson Valley	7.3	HIS/HOL	Johnson Valley	M 7.3 Landers 1992
20	Kramer Hills	6.2	LTQT	Edwards Air Force Base, Kramer Junction	
21	Lavic Lake	7.1	HIS	Marine Corps Air Ground Combat Center	M 7.1 Hector Mine 1999

2. Seismic and Geologic Hazards

Table 2-4. Faults with Projected Potential for M 5+ Earthquakes

ID	Fault Zone Name	Maximum Probable Magnitude	Fault Period (Age)	Nearby Communities and/or Military Facilities	Historical Earthquakes
22	Lenwood-Lockhart	7.4	HOL/LTQT	Edwards Air Force Base, Kramer Junction	
23	Long Canyon	6.2	HOL	Morongo Valley, Yucca Valley	
24	Manix	7.0	HIS	Newberry Springs	M 6.5 Manix 1947
25	Mesquite Lake	7.0	HIS	Joshua Tree, Twentynine Palms	
26	Mirage Valley	6.7	LTQT	El Mirage	
27	Mt General		HOL	Barstow, Daggett	
28	North Frontal	7.1	HOL/LTQT	Apple Valley, Hesperia, Lucerne Valley	
29	Old Woman Springs	7.4	HOL	Johnson Valley, Lucerne Valley	
30	Owl Lake	6.8	HOL	Fort Irwin	
31	Panamint Valley	7.5	HOL	Fort Irwin	
32	Pinto Mountain	7.5	HOL	Joshua Tree, Twentynine Palms, Yucca Valley	
33	Pisgah-Bullion	7.1	HIS	Joshua Tree, Landers	
34	Red Hill-Etiwanda Avenue	7	HOL/LTQT	Rancho Cucamonga, San Antonio Heights, Upland	
35	Red Pass	6.6	HOL	Baker	
36	San Andreas	8.5	HIS/HOL/LTQT	Crestline, Forest Falls, Oak Glen, San Bernardino, Yucaipa, Lytle Creek, Wrightwood	M 8.0 Fort Tejon 1857
37	San Antonio	6.5	LTQT	Rancho Cucamonga, San Antonio Heights, Upland	
38	San Gorgonio Mountain	5+	LTQT	Angelus Oaks, Big Bear, Forest Falls	
39	San Jacinto	7.5	HOL/LTQT	Bloomington, Colton, Fontana, Loma Linda, Muscoy, Rialto, Grand Terrace, Devore, Lytle Creek, San Bernardino	M 6.8 San Jacinto 1918, M 6.3 Loma Linda 1923
40	Cucamonga (Sierra Madre)	7	HOL	Fontana, Lytle Creek, Rancho Cucamonga, Upland, Rialto	
41	Silver Reef	6.2	HOL	Big Bear City, Lucerne Valley	
42	Southern Death Valley	7.3	HOL/LTQT	Fort Irwin	
43	Tank Canyon	6.8	HOL	Fort Irwin, Trona	
44	Tunnel Ridge	6.4	LTQT	Crestline, Cedarpines Park, Lake Arrowhead	
45	Waterman Canyon	6.5	LTQT	Crestline, Lake Arrowhead, Running Springs, San Bernardino	

Abbreviations: Fault Period (Age): HIS = Historic; HOL – Holocene; LTQT = Late Quaternary

Sources: Southern California Earthquake Data Center, 2016; Caltrans Fault Database, 2016; and United States Geological Survey, 2016.

2.2.3 LIQUEFACTION

The potential for liquefaction exists in areas with relatively loose, sandy soils and high groundwater levels (less than 50 feet in depth) during long-duration, strong seismic ground shaking. Several areas in the county have subsurface soil and groundwater conditions conducive to seismic-induced liquefaction. Secondary effects of liquefaction can include the loss of load bearing capacity below foundations, settlement in ground level, and instability in sloped grounds. Areas most susceptible to liquefaction include soils along water bodies, areas in and surrounding dry lakes, and areas where the water is near the surface.

Liquefaction example in San Bernardino
Source: USGS Photo Gallery

Valley Region

Portions of the Valley are comprised of relatively loose alluvial sediments susceptible to liquefaction. Historical groundwater levels are also relatively high (less than 50 feet below surface). While groundwater pumping has caused the groundwater levels to decline below historical levels, seasonal weather or groundwater recharge can raise water levels and increase the potential for liquefaction. Areas most susceptible to liquefaction include the alluvial fans and floodplain deposits along the Santa Ana River, Cajon Creek, and Lytle Creek. Southern Chino and San Bernardino are also susceptible to liquefaction, and Ontario's New Model Colony (the Ranch area) has been susceptible to liquefaction.

Mountain Region

Generally, mountain communities do not have a high probability of liquefaction, because the region is underlain predominantly by rock. However, liquefaction is still a concern in smaller areas in the vicinity of bodies of water such as Big Bear Lake, Erwin Lake, and Baldwin Lake. This includes: 1) a small area between Big Bear Lake and Erwin Lake with high groundwater levels; 2) a small area between Big Bear Lake and Baldwin Lake; and 3) areas surrounding Big Bear Lake.

Desert Region

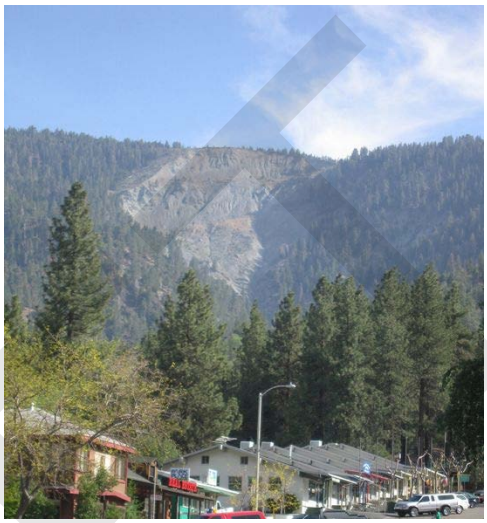
In the Desert Region, liquefaction is most likely to occur in areas of alluvial deposits with relatively shallow groundwater or around dry lakebeds. Although dry lakes hold water for only a few weeks of the year, groundwater can be near the surface in the lakebed and surrounding alluvium. In the High Desert, liquefaction potential is high along the Mojave River (eastern Victorville, west Apple Valley, Hesperia, and Twentynine Palms). Also of concern are areas adjacent to faults that form groundwater barriers such as local areas southwest of the Calico Fault near Barstow, the Helendale Fault in Lucerne Valley, and the Lockhart Fault. Areas along the Colorado River also pose a high liquefaction potential.

Figure 2-2 Liquefaction and Landslide Susceptibility. Official maps detailing potential liquefaction hazards can be found online.

2. Seismic and Geologic Hazards

2.2.4 LANDSLIDES & SLOPE INSTABILITY

Landslides typically occur on hillsides or in steep terrain. Landslides are influenced by the nature of the rock or soil type, slope angle, groundwater levels, and rainfall. Landslides can also be affected by construction activity, unusual natural or artificial wetting, and erosion. Other equally important factors that contribute to landslides include the discontinuity orientation of the rock in relation to the slope direction; the physical condition and degree of weathering of the rock and soil; and the frequency, location, and magnitude of earthquakes. Because of the mass of soil, rocks, and debris involved, however, a landslide can produce catastrophic damages to residences, structures, and infrastructure in its path.



Historical landslide above Wrightwood
Source: USGS Photo Gallery

Valley Region

In the Valley Region, landslides are of concern in areas of moderate relief, such as in the Chino Hills, or in areas adjacent to high relief, such as along the southern fronts of the San Gabriel and San Bernardino mountains. In addition, localized areas in the Valley Region that have a potential for landslides include incised riverbanks and the areas surrounding large open excavations or quarries. Landslides have periodically occurred in Valley communities such as Yucaipa, Highland, Chino Hills, and San Bernardino that are adjacent to or front hillsides or local mountains.

Mountain Region

Landslides of all types are common in the mountains due to steep slopes, sharp narrow ridges, and steep-walled incised canyons and valleys, when combined with adverse geologic structure, high rainfall, and earthquakes. The landslides range in size from small rock falls or topples along road cuts to large landslide complexes along the steep south margin of the mountain ranges. Historical and recent landslides have occurred in Wrightwood, Forest Falls, and other locations. The late Pleistocene-early Holocene Blackhawk landslide cited below originated in the Mountain Region.

Desert Region

In the Desert Region, landslides are less of a concern due to the low annual rainfall. The types of landsliding expected during an earthquake would include rock falls or debris flows. The most famous landslide is the Blackhawk Landslide, a prehistoric landslide that displaced an estimated billion cubic feet of material in the southeast corner of Lucerne Valley. Landslide hazards have been identified in the communities of Yucca Valley, Twentynine Palms, Hesperia, Victorville, and Apple Valley according to public safety technical reports prepared in support of comprehensive general plan updates.

Figure 2-2 shows the County's data on potential landslide hazards. Other maps detailing potential landslide hazards can as a large PDF map or online web map (open layers select CGS Mapsheet 58).

Figure 2-2 Liquefaction and Landslide Susceptibility

2. Seismic and Geologic Hazards

This page left intentionally blank

2.2.5 CORROSIVE SOILS

Corrosive soils contain chemicals that can react with construction materials (e.g., concrete and ferrous metals) and may damage foundations and buried pipelines. Corrosive desert soils have high contents of chloride, sodium, or sulfate minerals. Soils with high amounts of sulfate minerals, such as gypsum, are harmful to concrete, particularly in acidic soil (low pH). High chloride concentrations from saline minerals can corrode metals (carbon steel, zinc, aluminum, and copper). Low pH and/or low resistivity soils could corrode buried or partially buried metal structures. The Geologic Hazard Overlay District includes corrosive soils as a hazard that should be considered in all types of new structures, including foundations, piping, and buildings.

Corrosive soils can erode water main pipes, steel, and foundations, leading to hazardous conditions.

Desert Region

Highly corrosive soils for concrete are found in Apple Valley, Hinkley, Lucerne Valley, Barstow, Daggett, and Newberry Springs. Moderately corrosive soils for concrete also exist in Adelanto. Corrosive soils to metals can be found in Adelanto, Hinkley, Lucerne Valley, and Newberry Springs. Moderately corrosive soils to metals are in Victorville, Apple Valley, Hesperia, and Lucerne Valley. Corrosive soils to metals are found in Twentynine Palms and the Marine Corps Air Station. Certain playas (e.g., Searles Lake, Mesquite Lake, Bristol Lake, Cadiz Lake, Dale Lake) produce commercially valuable corrosive minerals, but many remote areas of the desert are unmapped for corrosive soils.

Mountain Region

In the Mountain Region, corrosive soils to concrete have not been identified, although highly corrosive soils to metals have been identified in the Wrightwood, Big Bear, and Baldwin Lake areas. The Forest Falls area may also have a ribbon of soils that is highly corrosive to steel. Soil hazards for radon and other hazardous minerals are discussed in later sections of this chapter.

Valley Region

Moderately corrosive soils to concrete are found in eastern Ontario and the Ontario Ranch area, southern and southeastern Chino, Rancho Cucamonga foothills, Fontana and Upland north of SR-210, large portions of Yucaipa, Highland, and central San Bernardino. Moderately corrosive soils for steel are concentrated in the entire Chino Valley, San Bernardino, Yucaipa, Grand Terrace, and Loma Linda areas. Highly corrosive soils to steel are found in select ribbons throughout the Chino Valley.

The NRCS prepares soil surveys statewide, although much of San Bernardino County has not been surveyed. Soil survey data and hazard ratings for the county can be accessed as an online web map.

2. Seismic and Geologic Hazards

2.2.6 SETTLEMENT/SUBSIDENCE

Differential seismic settlement occurs when seismic ground shaking from an earthquake causes one type of soil or rock to settle more than another type. Subsidence effects include the formation of ground fissures, ground cracking, and uneven settlement that could damage building foundations, pipelines, and other infrastructure. While subsidence can be caused by the extraction of oil and gas, subsidence in San Bernardino County is primarily the result of groundwater extraction, prolonged drought, and geologic conditions. Continued declines in groundwater levels and persistent drought conditions, locally and statewide, have led to passage of the Sustainable Groundwater Management Act of 2015.

Subsidence in Lucerne Valley, Mojave Desert
Source: USGS Photo Gallery

Valley Region

The alluvial valley area in southwestern San Bernardino County (the La Verne, Chino-Riverside, and Bunker Hill-Yucaipa areas) has experienced subsidence from groundwater withdrawal. Subsidence up to 6 feet is possible in these areas. Specific occurrences of subsidence include up to 4 feet in Chino Basin and undetermined levels in Yucaipa Valley and San Bernardino. Areas at medium to high risk of subsidence include the Chino and Rialto-Colton subbasins. The Bunker Hill and Yucaipa basins, both subject to past subsidence, have a medium-low risk.

Mountain Region

Land subsidence is known to occur in basins containing aquifer systems that at least in part consist of fine-grained sediments and that have undergone extensive groundwater development. Generally, subsidence is not considered a significant geologic hazard in the Mountain Region as it is underlain predominantly by bedrock that is not subject to movement like fine-grained sediments. However, CGS has detected small amounts of land deformation (uplift and subsidence) in the area between Big Bear Lake and Baldwin Lake, and the area near Big Bear Lake and Sugarloaf.

Desert Region

Subsidence due to groundwater extraction affects the Desert Region, particularly near dry lakebeds in the Mojave and Morongo basins (e.g., El Mirage Lake, Harper Lake, Coyote Lake, and Troy Lake/Newberry Springs). Subsidence of two feet occurred in Lucerne Valley from 1969 to 1998, and Fort Irwin reported a foot of subsidence from 1993 to 2006. Areas at high risk of future subsidence include the El Mirage Valley, Lower Mojave, Harper Valley, and Lucerne Valley. Areas at medium-high risk include the Upper River Mojave, Irwin Subbasin, Fremont Valley, and Twentynine Palms.

Figure 2-3 displays estimated subsidence risk in San Bernardino County according to DWR. Additional subsidence maps from DWR's Groundwater Information Center are accessible online.

Figure 2-3 Land Subsidence Potential

2. Seismic and Geologic Hazards

This page left intentionally blank

2.2.7 EXPANSIVE AND COLLAPSIBLE SOIL

Expansive and collapsible soils are some of the most common and costly geologic hazards if not mitigated. These soils are subject to changes in volume and settlement in response to wetting and drying. The change in volume of soil can exert enough force on a building, structure, pipeline, or even roads to cause damage. Expansive soils are typically characterized by clayey material that shrinks and swells as it dries or becomes wet, respectively. Collapsible soils consist of loose, dry, low-density materials that have weak cementation/cohesion that can be modified (collapse or compact) with the addition of water or weight. Soils with properties favorable to collapse include young fine-grained alluvial materials and wind-deposited soils, and soils with salts.

Expansive Soil
Source: USGS Photo Gallery

Valley Region

The Valley Region is unlikely to have expansive soils, with the exception of two areas. Monserate series soils in Grand Terrace have a moderate expansion potential. In the Chino Hills area, Chualar, Fontana, and Sorrento series soils have a moderate expansion potential. South of Chino Hills State Park, moderately expansive Monserate soils have also been mapped. Areas with collapsible soils with moderate to high levels of salts include parts of San Bernardino, south Ontario, and Chino. Much of the Valley Region is covered with either alluvial or wind-blown soils, so geotechnical investigations for individual projects in the area should evaluate the potential for collapsible soils on a case-by-case basis.

Mountain Region

Soils in the Mountain Region are moderately expansive in large portions of Crestline, Lake Arrowhead, Running Springs, Fawnskin, Big Bear City and Big Bear Lake, Holcomb Valley, and Barton Flats. However, collapsible soils are less likely in the Mountain Region, which typically receives more precipitation than other areas of the county. Geotechnical reports for individual projects should evaluate the potential for expansive soils and mitigate the condition if present.

Desert Region

Much of the Desert Region has low to moderately expansive soils. In select areas, such as Lucerne Valley and dry lakebeds, the soils can be highly expansive. The Desert Region has the highest potential for collapsible soils due to its aridity, the prevalence of both alluvial and wind-deposited soils, and soils with salts. Geotechnical investigations for individual projects in the Desert Region should evaluate the potential for expansive or collapsible soils and mitigate the condition if present.

Soil survey information and hazard ratings for San Bernardino County can be accessed from the NRCS as an online web map.

2.2.8 HAZARDOUS MINERALS

Naturally occurring hazardous minerals and substances are of concern in certain locations. Uranium, thorium, radon, arsenic, lead, and asbestos can all be found throughout the county. Uranium affects functioning of the kidney, brain, liver, heart, and lungs, while thorium increases the risk of cancers of the lung, pancreas, and blood and liver diseases. Radon is a radioactive gas that forms from the decay of uranium and thorium in rocks and soils. High levels of radon exposure are the second leading cause of lung cancer, after smoking. Asbestos is a mineral fiber in rocks and soil, most commonly in association with ultramafic rocks. Inhalation of asbestos fibers is known to cause lung cancer, mesothelioma, and other chronic lung diseases.

Morehouse talc mine in the Ibex Hills
Source: USGS Photo Gallery

Morehouse talc mine in the Ibex Hills
Source: USGS Photo Gallery

Valley Region

Uranium and thorium-containing minerals have not been reported in the Valley Region. In addition, statewide testing of indoor air for radon gas has reported only a few incidents in the Valley, although the moderate susceptibility range for radon extends to the border of the surrounding Chino Hills. Areas where tests occurred showed some indoor air concentrations of radon gas that were higher than recommended, namely the Alta Loma region of Rancho Cucamonga and parts of Ontario and San Bernardino. No naturally occurring asbestos deposits are known to exist in the Valley Region.

Mountain Region

Radioactive minerals are most likely to occur in areas of crystalline bedrock or areas underlain by materials derived from such bedrock typical of the Mountain Region. According to the State Public Health Department, a sample of radon tests showed that homes in Crestline and Green Valley Lake had higher than recommended levels of radon. Except for an identified isolated outcrop of fibrous amphibole minerals near Mount Baldy, no naturally occurring asbestos deposits in the Mountain Region are known to exist that would pose a threat to public health and safety.

Desert Region

Uranium-containing minerals have been reported in isolated areas across the Desert Region, and thorium-containing minerals have been reported in Mountain Pass and west of Landers. Mountain Pass contains one of the few rare earth mines in the nation and is the source of naturally occurring radioactive minerals. Radon has been detected in the Twentynine Palms area. With respect to asbestos, former mines were located in the hills near Baker, Helendale, Barstow, and Apple Valley. Numerous asbestos-containing talc deposits are located south of Tecopa in Death Valley.

The CGS has not produced official maps of hazardous minerals for San Bernardino County.

2.3 IMPLEMENTING AGENCIES

Federal, state, and local government agencies play different roles in managing risks from seismic and geologic hazards due to earthquakes, landslides, soil conditions, and various other geologic hazards. Key agencies are as follows.

California Department of State Architecture

The Division of the State Architect (DSA) was formed after the Long Beach earthquake, which damaged more than 70 schools. Today, DSA provides design and construction oversight for K–12 schools, community colleges, and all state-owned or state-leased essential services buildings. "Essential services building" includes a fire station, police station, emergency operations center, California Highway Patrol office, sheriff's office, or emergency communication dispatch center. DSA develops accessibility, structural safety, and historical building codes and standards for buildings in California. DSA conducts Structural Safety, Access Compliance, and Fire and Life Safety reviews and approvals. State buildings and other state-funded construction, such as the UC or CSU systems, do not fall under the Field Act, so are not reviewed by DSA. However, these entities are required to obtain DSA approval for access compliance in accordance with Government Code Section 4450 to 4454.

California Department of Housing and Community Development

The California Department of Housing and Community Development's Manufactured Housing Program Division is responsible for administering the construction and alteration of commercial modulars, special purpose commercial modulars, and multifamily manufactured homes, monitoring design and construction through third-party agencies. Program staff also performs activities on behalf of the federal government as a state administrative agency. Housing and Community Development regulations establish minimum design and construction standards for all multifamily manufactured homes and mobile homes built before June 15, 1976, and commercial modulars and special purpose commercial modulars sold, rented, or leased. These regulations preempt any local requirement. Manufactured homes built after June 15, 1976, are subject to preemptive federal laws and regulations. More than 40,000 mobile homes, many of them occupied by seniors, are located in the county.

Office of Statewide Hospital Planning and Development

The California OSHPD, Facilities Development Division Building Standards Unit, is responsible for the development of administrative regulations and building standards for the construction of hospitals, skilled nursing facilities, licensed clinics, and correctional treatment centers. These regulations are developed, as necessary, to implement the provisions of the Alfred E. Alquist Hospital Seismic Safety Act of 1983. This responsibility includes establishing building standards governing construction of these facilities; reviewing the plans and specifications for new construction, alteration, renovation, or additions to health facilities; and observing construction in progress to ensure compliance with the approved plans and specifications. In summary, the OSHPD serves as a "one-stop shop" for all aspects affecting the

construction and rehabilitation of health facilities in California. This includes approximately 200 health care facilities throughout San Bernardino County.

California Geological Survey

The California Geological Survey (CGS) and its federal counterpart the United States Geological Survey (USGS) are responsible for providing informative research, mapping, and mitigation strategies for addressing seismic and geologic hazards in California and throughout the nation. These studies and reports help to inform CGS's data regulatory warehouse of seismic studies and mapping of hazards, including liquefaction, landslides, Alquist-Priolo fault mapping, and other data services. CGS, in concert with the California Department of Public Health, also provides maps, geologic information, and advice, and monitors activity on minerals-related environmental and public health issues such as asbestos, mercury, and radon. The program has an ongoing effort to provide geologic information on naturally occurring asbestos in California to local government agencies.

California Department of Transportation

The Caltrans Department bridge inspectors are responsible for maintaining the safety and integrity of over 24,000 bridges owned by the State of California and California's local government agencies. The Department is responsible for: conducting annual inspections; making structure work repair recommendations; determining the safe load capacity of all bridges; reviewing and approving encroachment permits and air space lease proposals involving structures; delivering plans, specifications and estimates for bridge maintenance on projects; and coordinating the protective coating work on over 800 state highway steel bridges.

After the 1971 Sylmar earthquake struck the Los Angeles area and damaged several bridges, Caltrans implemented a seismic safety program for state-owned bridges to strengthen 12,000 state bridges. Caltrans now administers the Local Bridge Seismic Safety Retrofit Program, established following the October 1989 Loma Prieta Earthquake. The purpose of this program is to provide funding assistance to local agencies for remedying structural seismic design deficiencies of public bridges on local streets and roads in California.

San Bernardino County Department of Building and Safety

Seismic safety of buildings is primarily addressed by adherence to safety standards and building codes. The Building and Safety Division's primary responsibility is the enforcement of Building Standards adopted by the State of California and the County of San Bernardino. These standards include the California Building, Electrical, Plumbing, Mechanical, and Energy Codes, and Disabled Access Regulations in Title 24 of the California Code of Regulations. The division also has responsibility for the enforcement of the California Mobile Home Park Act regulations in Title 25.

If a structure is in the geological hazard overlay, the building official will require the preparation of appropriate geotechnical studies that demonstrate that the project can be safely built, and these studies must be approved by the building official or designee prior to the issuance of building permits.

3. FLOODING HAZARDS

This chapter addresses five topics: 1) introduction to flooding hazards; 2) governmental regulations that address flood hazards; 3) an inventory of flooding hazards and events in San Bernardino County; 4) mapping of hazards; and 5) organizations responsible for addressing flooding in the county.

3.1 INTRODUCTION

Flooding is a significant threat to life and safety, the environment, property, natural resources, and the economy. San Bernardino County's topography, desert climate, and vast open spaces make it subject to rainfall and flooding. Flood hazards include riverine flooding, dam and levee inundation, urban flooding, alluvial fan flooding, and debris/mud flows. Since 2000, recorded flooding events have caused significant damages; 272 reported flooding events caused 54 injuries and fatalities and an estimated $233 million in damage to property, crops, public facilities, and infrastructure. This is one of the highest levels of events reported by a county in the nation. The continued frequency of flood events underscores the importance of assessing and addressing flood hazards as part of the countywide general plan.

Seven Oaks Dam, Highland, California

This chapter provides a discussion of the flooding hazards that may lead to loss of life, bodily injury, property damage, litigation, impacts to lifelines and infrastructure, and other economic costs. The objective of this chapter is to provide pertinent information on known and potential flooding hazards in San Bernardino County to assist the County in making land use decisions, planning for present and future development needs, and protecting public health and safety. As flood infrastructure is provided by many entities, this chapter addresses flood and drainage infrastructure owned and/maintained by the county, state, and federal government.

This chapter references a variety of publications from local, state, and federal governmental agencies that illustrate and describe flooding hazards in San Bernardino County. Primary information sources include the Federal Emergency Management Agency (FEMA), California Department of Water Resources (DWR), 2005 Safety Background Report, US Army Corps of Engineers (USACE), United States Geological Survey (USGS), California Geological Survey (CGS), County General Plan and Development Codes, and a variety of unpublished resources. A list of available references is provided in Chapter 7. No fieldwork was performed specifically for this report.

3. Flooding Hazards

3.1.1 REGULATORY SETTING

Federal law, state statutes, and local codes regulate planning and mitigation of flooding hazards, including inundation from dams and levees, riverine flooding, and urban flooding. The following pertain to the flood safety component of the Countywide Plan and environmental impact report.

Federal Laws and Regulations

Flood Control Acts of 1936 as amended

The Flood Control Act includes a series of legislative acts passed by Congress to fund a wide range of federal flood control projects. The Flood Control Act of 1936 and 1938 authorized dams, levees, and other flood control structures to be built by the USACE. The Flood Control Act continues to be amended to authorize flood control and levee projects across the nation. Dams built in San Bernardino County under this authority include the San Antonio Dam (1952-1960), Prado Dam (1941-2000), Mojave River Dam (1968-1971), and the Seven Oaks Dam (1991-2001), among others. The Flood Control Act continues to be used to obtain funding for rehabilitation and improvement of these and other dams. Dams and levees constructed by the Bureau of Reclamation (e.g., Parker Dam and others along the Arizona/county border) are authorized under the Reclamation Act of 1902.

Water Resources Development Act of 1974 as amended

Since 1974, Congress has enacted the Water Resources Development Act (WRDA) to guide the nation's priorities with respect to the development and maintenance of waterways. As part of the WRDA amendments of 1996, the National Dam Safety Program Act was created for the purposes of improving the construction, maintenance, and safety of dams through training, technical assistance, research, public awareness, and other programs. Federal agencies were also directed to adhere to "Federal Guidelines for Dam Safety." In 2014, the Water Resources Reform Development Act created a new National Levee Safety Initiative to promote consistent safety standards, establish levee safety guidelines, and provide funding to states for establishing levee safety programs. The WRDA and subsequent amendments also led to the development of the National Inventory of Dams and Levees, the first comprehensive inventory and safety rating of flood control infrastructure nationwide.

National Flood Insurance Act of 1968 as amended

The National Flood Insurance Act (NFLA) mandates that FEMA evaluate flood hazards for communities. FEMA prepares Flood Insurance Rate Maps that identify areas of high flood risks for communities across the nation. The act also created the National Flood Insurance Program to offer flood insurance to homeowners, renters, and businesses if their community participates in the program and adopts floodplain ordinances. In 1973, the NFLA was amended by the Flood Disaster Protection Act, which requires owners of structures in Special Flood Hazard Areas (SFHA) to purchase and maintain flood insurance as a condition for receiving federal assistance. The National Flood Insurance Reform Act (1994) codified the community rating system and incentive program, allowing further insurance rate reductions for communities exceeding FEMA regulations. This act was further amended in 2002 to address the issue of repetitive flooding.

Federal Executive Order 13690

In January 2015, President Obama issued Executive Order 13690 to improve the resiliency of communities and federal assets against flooding and losses associated with climate change and other threats. The Executive Order proposes a Federal Flood Risk Management Standard (FFRMS) that allows agencies to select one of three approaches for establishing the flood elevation and hazard area that they can use in siting, design, and construction. They can: 1) use data and methods informed by the best-available, actionable climate science; 2) build 2 feet above the 100-year flood elevation for standard projects and 3 feet above for critical buildings like hospitals and evacuation centers; or 3) build to the 500-year flood elevation. The FFRMS also applies a new standard outside of the mapped floodplain, since significant flood losses occur regularly outside FEMA-designated floodplains. These guidelines are advisory but affect federal and federally-funded projects in a community.

Federal Urban Flooding Awareness Act of 2015

Congress is currently considering a federal bill, HR 2616, Urban Flooding Awareness Act of 2015. This bill will direct FEMA to enter into an agreement with the National Academy of Sciences to conduct a study on urban flooding. It defines "urban flooding" as the inundation of property in a built environment, particularly in more densely populated areas, caused by rain falling on increased amounts of impervious surface and overwhelming the capacity of drainage systems. It requires the primary focus of the study to be on urban areas outside of special flood hazard areas. The bill directs the National Academy of Sciences to evaluate the latest research, laws, regulations, policies, best practices, procedures, and institutional knowledge regarding urban flooding. In 2016, a Congressional mandate was signed into law as part of the 2016 Omnibus Appropriations Act, directing FEMA to conduct a nationwide study focusing on urban flooding.

California Law and Regulations

Cobey-Alquist Floodplain Management Act of 1965 as amended

The Cobey-Alquist Act encourages local governments to plan, adopt, and enforce floodplain management regulations (Water Code Section 8400 et seq.) in their communities to prohibit structures that endanger lives or restrict the capacity of floodways. In 1972, the Cobey-Alquist Act was strengthened to encourage implementation. Where a federal flood control project report has been issued that designates floodway boundaries, DWR or the State Reclamation Board will not appropriate money in support of the project unless the applicable agency has enacted floodplain regulations.

To be eligible for funding, local floodplain regulations are required to provide that construction of structures in the floodway that may endanger life or significantly reduce its carrying capacity shall be prohibited. Development will be allowed within the "restrictive zone" between the floodway and the limits of the floodplain as long as human life and the carrying capacity of the floodplain are protected. Finally, the act supports restrictive general plan policies and zoning provisions with respect to floodplain management. Floodways and floodplain boundaries should be designated and a consistent land use designation given to affected lands in the land use element.

3. Flooding Hazards

General Plan Law, Government Code

The Government Code, Section 65302, requires general plans to contain detailed information on flooding risks and hazards, including dam inundation, flood zones, and other flood-related hazards. In the latter part of 2007, the California Legislature also passed a series of flood legislation bills supporting the integration of local land use planning and mitigation measures in statewide floodplains. Taken together, these bills require cities and counties to:

- Employ the land use element of the general plan to identify, set aside, and annually review areas subject to flooding identified by floodplain mapping prepared by FEMA and the DWR.
- Identify in the conservation element (or other general plan element) the rivers, creeks, streams, flood corridors, riparian habitat, and land within a community that may accommodate floodwaters for the purposes of stormwater management.
- Identify flooding hazards due to dam and levee inundation and other flooding risks; structures located within or affected by potential flooding; and local, state, and federal agencies responsible for addressing flooding.
- Identify existing and planned development in flood hazard zones, including structures, roads, utilities, and essential public facilities. Locate, when feasible, new essential public facilities outside of SFHAs or identify methods to minimize damage if facilities are located there.
- Establish in the safety element (and other elements that must be consistent with it) a set of comprehensive goals, policies, and feasible implementation measures for protection of the community from unreasonable risks of flooding.

Alluvial Fan Legislation

Following the enactment of state legislation, the DWR announced a partnership with the Water Resources Institute to coordinate the Alluvial Fan Task Force. DWR appointed a task force to study alluvial fan floods across a 10-county southern California area. The members were charged with developing a Model Ordinance and local planning tools that would provide a model for future land use decisions on alluvial fans that are nonprescriptive, flexible, and allow local governments to adapt to their local conditions and each development. Working with CGS, the Model Ordinance and local planning tools were intended to minimize public and private losses and damages that may result from the flood risks and related hazards posed by development on alluvial fans. As part of the hazard identification process, alluvial fan maps were produced that identified areas of particular concern, many of which are in San Bernardino County. Although FEMA recognizes alluvial fan flooding, unmapped urbanized fans are not subject to FEMA/NFIP insurance or mitigation criteria. Even today, few local governments have special flood regulations designed to address alluvial fan flooding.

Key Local Codes and Regulations

General Plan Policy

The San Bernardino County General Plan addresses flood hazards through land use designations and policy. The Floodway (FW) Land Use District is intended to: 1) identify and preserve areas for channeling flood flow, 2) protect floodways from encroachment by land uses that would be endangered by flooding or impede channel functioning, 3) prevent loss of life or property, and 4) coordinate flood drainage and land development. FW districts include areas identified as major flood channels by the County, areas with historical flooding, and areas identified as floodways by FEMA. In addition, the Safety Element includes a broad goal and policies to address building design, site design, permitting, and various programs that address flooding concerns throughout the county.

The San Bernardino County General Plan also contains a land use compatibility matrix that ranks specific land uses that are within or proposed in the 100-year floodplain. Land uses are ranked according to three levels of compatibility—permitted, generally incompatible, and restricted. However, the land use compatibility matrix does not include the 500-year floodplain, potential 100-year floodplains as identified by DWR, or areas where FEMA has determined there is possible, but undetermined flooding potential (Zone D). The land use compatibility matrix and Safety Element policies provide a foundation for the implementation of the Floodplain Safety Overlay District and associated regulations. The land use compatibility matrix also does not reflect recent federal law that raises the minimum elevation for federal buildings in flood zones.

Floodplain Safety Overlay District

The General Plan and Development Code provide policy guidance to minimize flooding hazards through the application of a land use compatibility matrix, goals and policies. The Floodplain Safety (FP) Overlay District in Section 82.14 of the San Bernardino County Development Code implements the general plan goals and policies to protect public safety and health and minimize public and private economic losses due to flooding events. As part of the 2007 General Plan and Development Code update, flood hazard maps were prepared that identify areas likely to be subject to the 100-year and 500-year floods. The FP Overlay has three zones (FP1, FP2, and FP3) based on mapping from FEMA and the SBCFCD. The County's flood hazard maps were last updated in 2007 and do not include the best available maps prepared by DWR. FEMA has issued new map revisions dated 2008 and 2016.

All land use applications and development permits proposed for new construction or the extension, conversion, or alteration of existing structures must comply with FP Overlay requirements. Should a FP3 (area of undetermined, but possible flooding) overlay apply, a field investigation is required to determine if the project and land uses proposed on a site would be detrimental to the drainage way. Prior to the issuance of a building permit, any development in an FP Overlay requires an elevation certificate. The project must also adhere to development standards (anchoring, grading, elevation of first floor, flood-proofing, utility standards, etc.) specified in the development code. A review of the building plans for adherence of development standards and a comparison of grading plans and final elevations to the base flood elevation are also required prior to permit issuance.

3.1.2 IMPORTANT TERMS

The following important terms for flooding hazards are used in this section.

Dams and Reservoirs

A barrier built across a watercourse used for impounding water. Dams with associated reservoir storage can reduce peak flood flows by storing storm water for later release and proper management. When a large storm occurs above the reservoir, storm waters are captured within the dam or reservoir, which allows for the regulated release of waters without exceeding downstream channel capacity.

Dam Safety Action Classification (DSAC)

The USACE Dam Safety Program uses risk to inform how it manages the approximately 700 dams it operates and maintains throughout the country. The USACE developed the following classification system for rating the individual dam safety risk considered as a combination of probability of failure and potential life safety, economic, environmental, or other consequences.

- DSAC I (Very High Urgency): dams in which failure is imminent under normal operations
- DSAC II (High Urgency): dams where failure could begin during normal operations or the result of an event
- DSAC III (Moderate Urgency): dams that are significantly inadequate with a moderate-high probability of failure
- DSAC IV (Low Urgency): dams that are inadequate but the risk of failure is very low
- DSAC V (Normal): dams that are considered to be adequately safe

Dam (or Basin) Hazard Potential Ratings

To encourage individual and community responsibility for dam safety, FEMA coordinates partnerships through the federal Interagency Committee on Dam Safety (ICODS). ICODS defines the potential hazard to the downstream area resulting from failure or misoperation of the dam or facilities. It should be noted that the hazard potential is not a measure of the condition or structural integrity of the facility, but is based on structural features (height), capacity (acre feet of water), and other criteria.

- **Low.** Failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
- **Significant.** Failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns.
- **High.** Failure or misoperation will probably cause loss of human life and would cause excessive economic loss to infrastructure, buildings, transportation systems, agriculture, and public utilities.

Debris Basins

Debris basins are typically built near the base of mountains on streams that carry excessive debris during above-normal flows. Debris basins can reduce flow velocities to allow large rocks, debris, and sediments to be separated from the storm waters, which are allowed to pass through. As a result, debris removed from the flows protect downstream facilities from damage caused by debris loads.

Debris/Mudflow

A mudflow is a flood-induced condition where a mass of water-laden to saturated mud flows rapidly downslope carried by a current of water. This condition usually happens when heavy rains fall on land, and in particular hillsides, without adequate surface vegetation to absorb the rainfall. Areas affected by recent fires or downhill of a burn area are especially high risk for damage from mudflows.

DWR Awareness Data

The California Department of Water Resources conducts an Awareness Floodplain Mapping project to identify all pertinent flood hazard areas for areas that are not mapped under the Federal Agency Management Agency's (FEMA) National Flood Insurance Program (NFIP) and to provide the community and residents an additional tool in understanding potential flood hazards currently not mapped as a regulated floodplain. The awareness maps identify 100-year flood hazard areas using approximate assessment procedures. These floodplains are identified simply as flood prone areas without specific depths and other flood hazard data; they are not FEMA regulatory floodplain maps.

Flood

A flood refers to the rising and overflowing of a body of water onto normally dry land that is often caused by storm events or breaches of flood control infrastructure. While there are many different types of flooding that are recognized for communities, the three common types of flooding in San Bernardino County are alluvial fan, riverine, and urban flood as defined below.

- **Alluvial Flood.** Alluvial flooding occurs on the surface of an alluvial fan or similar landform that originates at the apex, and is characterized by high-velocity flows, active erosion, sediment transport, and deposition; and unpredictable flow paths. Alluvial fan flooding is depicted on a Flood Insurance Rate Map as Zone AO, with a flood depth and velocity.

- **Riverine Flood.** Riverine flooding occurs when excessive rainfall or heavy snow melt causes water to rise and overflow the edges of a river, bank, or channel. Flash flooding, a type of riverine flood, is characterized by an intense, high velocity torrent of water, often accompanied by debris, which occurs in a river channel with little to no warning.

- **Urban Flooding.** Urban flooding is caused when heavy rainfall creates a flood independent of an overflowing water body, such as when intense rain overwhelms the capacity of an urban drainage system. An urban flood is more common in areas that lack or have undersized drainage systems.

3. Flooding Hazards

Floodplain

A floodplain is the area, adjacent to a watercourse or other body of water, subject to recurring floods. Floodplains may change over time as a result of natural processes, the characteristics of a watershed, or the construction of bridges or channels. FEMA maps areas subject to the 100-year flood, a storm with a 1 percent chance of being equaled or exceeded in any given year, and moderate flood hazards, defined as an area having up to a 0.2 percent annual chance (or 500-year) of flooding.

Flood Management

Flood management refers programs of corrective and preventive measures for reducing flood damage. These measures take a variety of forms and generally include zoning, subdivision, or building requirements and special-purpose floodplain ordinances. Flood-proofing measures protect a structure or its contents against flooding that would otherwise cause damage. Various methods may be considered, depending on site conditions, cost, and the nature of the facility to be protected.

Inundation Zone

The inundation zone refers to a defined area downstream from any dam or impounded body or source of water (including reservoirs, large above ground water tanks, lakes, etc.) that could be flooded in the event of a sudden or complete failure of the structure. The inundation zone could also include levees that are breached or compromised, causing water to flood adjacent areas.

Levees

A levee is a structure that is designed and constructed to contain, control, or divert the flow of water to provide protection from temporary flooding. Earth embankments are placed along either side of a stream to contain storm waters and protect surrounding lands from inundation. Some levee systems are built to protect farmland, while others provide flood protection for industrial, commercial, and residential facilities. FEMA accredits levees that meet the requirements set forth in Title 44 of the Code of Federal Regulations, Section 65.10. FEMA and USACE have set up criteria for evaluating the structural integrity of flood control levees that fall under their respective jurisdiction.

Structural Failure

Structural failure is primarily a man-made cause or lack of maintenance of any flood control facility that can result in catastrophic flooding. Because development downstream of these facilities is reliant upon their integrity, failure of such structures results in large loss of property and sometimes life.

Watershed Management

Watershed management refers to practices and measures designed to improve land use, alleviate flooding, and reduce erosion and sedimentation. Watershed management may be achieved through combinations of land treatment and structural measures. Land treatment measures may consist of agricultural practices to enhance the vegetative cover designed to reduce overland flow and runoff and to control erosion, stabilization of stream channels, drainage mains and laterals, and irrigation-water management. The methods also include revegetation of bare soil, especially after a fire, elimination of overgrazing, contour plowing, strip cropping, terracing, and mulch tillage.

3.1.3 RECENT FLOODING EVENTS

San Bernardino County has historically been subject to damaging floods. Since 2000, the county has been subjected to about 272 reported floods, causing more than 50 injuries and fatalities and damages of $233 million in 2014 dollars (HVRI 2015). Table 3-1 lists some of the most damaging floods in recent history to affect San Bernardino County, including their location and estimate of damages.

Table 3-1. Summary of Major Flooding Events in San Bernardino County

Name of Flood and Date of Occurrence	Hydrologic Region	Description
1862 Great Flood December 24, 1861 to Feb 4, 1862	South Coast Hydraulic Region	The Great Flood of 1862 was the largest flood event to hit the west coast of the United States, including California, during recorded times. The storm in California lasted 43 days and extended into the Inland Empire. The Santa Ana River created an inland sea 4 feet deep and 4 miles away from the river. The Santa Ana, San Gabriel, Rio Hondo, and Los Angeles Rivers merged into a single body of water extending from Signal Hill to Huntington Beach. The Agua Mansa community was swept away on January 22nd. The storm and flooding destroyed one-quarter of the taxable real estate in California, valued at more than $10 million in 1862, and forced the state into bankruptcy. The USGS considers the storm a once in a 500 to 1,000 year even (e.g., ARkStorm or "Atmospheric River 1000-year Storm'). A similar event today would require evacuation of up to 1.5 million residents in the state, and cost upwards of $725 billion in losses.
1938 Great Flood March 1-5, 1938	Flash Flooding South Coast Hydrologic Region	Major flooding was generated by storms in the upper Santa Ana River watershed. Some areas received over 30 inches of rain in just five days. The flood destroyed more than 100 bridges, 800 miles of roads and highways, and 150 homes and left more than 1,000 people homeless and 22 dead. All communications were cut off, and the only routes open were by foot or by air. Rail transportation was halted for 30 days. All utility infrastructures were lost, including electric lines, natural gas lines, domestic water supply lines, telephone lines, and sewage lines/plants. Flooding was extensive in Victorville and Wrightwood areas. Property losses exceeded $11 million dollars in San Bernardino County alone (exceeds $200 million today).
High Desert Storms July 1958	Flash Flooding South Coast Hydrologic Region	Severe hailstorm caused a million dollars of damages to roads, highways (U.S. Route 66), and communication lines in various High Desert communities, including Barstow, Twentynine Palms, Daggett, and Mountain communities, including Forest Home and the Mill Creek area. Several homes were severely damaged, and one was pushed off its foundation. Flood waters ran unimpeded through motels, homes, and businesses. Major landslides, a result of a cloudburst on burned hillsides, created a 10-foot high, 300-foot-wide landslide on the highway at Forest Home. Hailstorm also caused thousands of dollars of damage to apple orchards in the Oak Glen community.
1969 Great Flood January/February, 1969	Slow Rise Flood, Debris Flow, Stormwater South Coast Hydrologic Region	The "great" floods of 1969 exceeded rainfall intensities and runoff of the 1938 floods. Fifty inches of rain fell on Mount Baldy. Although flood control facilities functioned well during the January flood, there was insufficient time to make repairs and maintenance. Property damages were widespread and included homes, roads and bridges, most buildings, agriculture, airports, communication lines, railroad lines, power plants, sewer plants, water supply lines, natural gas lines, military bases, and flood control facilities. Monetary losses in San Bernardino County exceeded $54 million and 13 people died. Severe flooding throughout Southern California caused $213 million in property losses ($2015) and 115 fatalities. The region was declared a national disaster area.
1978 Floods February 5–13; and February 27–March 6	Flooding South Coast Hydrologic Region	Hardest-hit areas included Ontario, Rancho Cucamonga, and Upland areas. Yucaipa, Highland, and Loma Linda were also heavily flooded. Hundreds of people were evacuated from unsafe locations. San Antonio Creek changed its course twice. Landslides, triggered by heavy rains, damaged homes and vehicles. The storms caused more than $25 million in damages, including significant damages in the High Desert region. President Carter declared the county a disaster area.

3. Flooding Hazards

Table 3-1. Summary of Major Flooding Events in San Bernardino County

Name of Flood and Date of Occurrence	Hydrologic Region	Description
1980 Floods February 13–21	Flooding South Coast Hydrologic Region	Six separate weather fronts swept across southern California from February 13–21, 1980, leaving 30 people dead and more than $500 million in damages. In September 1979, Harrison Canyon burned again. In 1980, four different storms unleashed debris flows that overwhelmed the basin each time. Forty homes on and near Hampshire Avenue were damaged or destroyed. The fourth storm buried homes up their eaves. A group of 32 homeowners sued, and the City of San Bernardino and the flood control district were found liable for $4 million in damages. About 25 homes on Hampshire Avenue were subsequently removed to make way for a floodway.
1998 Flash Floods February 23–24 1998	Flash Flooding South Coast Hydrologic Region	A powerful Pacific storm fed by El Nino conditions slammed into southern California, causing widespread flooding. Strong winds felled trees and snapped utility lines. Snow levels dropped to 1,400 feet in the high deserts and several feet in higher elevations. In the High Desert, flooding damaged scores of homes, while hundreds of homes and businesses in other communities suffered minor damage. Many roads, rail lines, and bridges were damaged or closed, including I-15 through the Cajon Pass. Swift-water rescues occurred in Colton, Redlands, and elsewhere. Persistent wet weather caused thousands of cows to drown and succumb to exhaustion. Damages, cleanup, and emergency services for southern California counties exceeded $100 million.
Forest Falls Landslide July 11, 1999	Flash Flooding, Landslide, Debris flow South Coast Hydrologic Region	A high-velocity debris avalanche resulted from high-intensity monsoon rains in Forest Falls and on Yucaipa Ridge. Intense rainfall produced boulder debris flows particularly in the Spring Creek, Rock Creek, and Slide Creek drainages. Debris flows overtopped natural channels, spreading boulder debris over extensive areas. Eyewitness accounts recorded three waves of flows reaching up to 25 feet in height and a minimum velocity in the range of 40 to 55 miles per hour. Debris flows deposited wide stretches of boulder-laden debris up to 6 feet deep on the only access road to Forest Falls, isolating the community. Over 50 homes were damaged or destroyed.
Christmas Day Debris Flow December 25-26, 2003	Debris Flow South Coast Hydrologic Region	This flood event was generated by heavy rainfall exceeding 8 inches in Lytle Creek and other locations. Intense rainfall caused mud, water, and rock slides that began near Crestline and continued down through Waterman Canyon. At Camp Sofia, 14 people were swept to their deaths. This event also washed out two bridges downstream. At Lytle Creek, flooding destroyed the road in the Scotland area, and debris pushed across the frontage road at I-15 near Glen Helen. Debris flows at City Creek covered a portion of the runway at San Bernardino International Airport with 18 feet of mud. At Cable Canyon, a mudslide killed 2 people at the KOA campground and destroyed 32 trailers. 33 of 34 debris basins along the foothills filled with debris.
New Year Flood of 2005 January 5-11, 2005	Mud flow, flash flood South Coast Hydrologic Region	Five days of rainfall caused widespread damage throughout southern California. President Bush declared 7 counties in Southern California disaster areas. A pregnant woman was swept away and drowned by City Creek in Highland, and Lytle Creek was over 200 feet wide. The Mojave River flooded 3 homes and caused severe damages in Hesperia and Oro Grande. In the Devore area, debris on Interstate 215 blocked the freeway. In Big Bear City, 111 homes, businesses, and schools were flooded. In the Lake Arrowhead area, 3 homes were destroyed by mudslides and 7 others damaged. A hotel in Crestline was destroyed by a mudslide. Most highways in the San Bernardino Mountains were closed due to washouts, landslides, or flooding.
Unnamed Floods December 17, 2010, through January 4, 2011	Mud flow, flash flood South Coast Hydrologic Region	A series of storms fueled by tropical moisture pounded Southern California, the Mojave Desert, and Great Basin during the last ten days of 2010. Extremely heavy snow and widespread flooding caused vehicle accidents, swift water rescues, and extensive damage to property and infrastructure. In Highland, more than 10 inches of rain caused a mudslide that damaged 30 homes and resulted in the evacuation of 200 residents—causing more than $20 million in damage alone. The county was declared a disaster area, with 13 communities proclaiming an emergency and with damages estimated to exceed $100 million throughout San Bernardino County.

Source: Alluvial Fan Task Force, FEMA, and CalOES.

3.1.4 HYDROLOGIC SETTING

The following section briefly provides an overview of the hydrology of the Valley, Mountain, and Desert regions and the various flooding hazards most prevalent in each region. Figure 3-1 provides a general map of waterways in San Bernardino County.

Desert Region

The Desert Region is composed of mountains, alluvial fans, playas, basin, plateaus, and dunes. Many of these features result from the erosive power of running water. However, significant surface flow is scarce, ephemeral, and usually the result of flash floods. These events may result in stream channels taking the form of alluvial fans, discontinuous ephemeral channels, single-thread channels with floodplains, and compound (braided) channels. The Mojave and Southern Mojave watersheds are the primary geographic and hydraulic features. Major hydrologic features include the Lower Colorado River and two intermittent rivers—the Mojave River and Armargosa River. Drainage for the High Desert remains in the region and often flows into dry lakebeds and playas. These rivers are dry most of the year. Infrequent storms are often intense, watercourses are erosive, and vegetation sparse.

Mountain Region

The Mountain Region is composed of the San Bernardino Mountains, which are part of the Transverse Ranges of the Southern California mountain chain. The Mountain Region consists of steep terrain with multiple peaks exceeding 10,000 feet and peaking at Mount San Gorgonio. Drainages include the Santa Ana River, Mojave River, Whitewater River, San Gorgonio River, Lytle Creek, Cajon Wash, San Antonio Creek, Deep Creek, Mill Creek, Mission Creek, and other creeks and washes. Although there are smaller watersheds within the Mountain Region, most of the water flow (e.g., snow melt, natural seeps, and springs) drains to the Santa Ana and Mojave watersheds. The southern and western portions of the Mountain Region flows southerly and are part of the Santa Ana River Watershed. The northern portion flows northerly into the Mojave River Watershed. The Mountain Region also has several large lakes: Big Bear Lake, Lake Arrowhead, and Silverwood Lake.

Valley Region

The inland valleys in San Bernardino County are bounded by the San Bernardino and San Gabriel mountain ranges. Associated with many mountain ranges are alluvial fans, which are fan-shaped landforms that form along the base of a mountain front by the buildup of stream sediments and debris flows. Elevation in the urbanized valley/foothills ranges from 700 feet near Rancho Cucamonga to around 4,000 feet near Yucaipa. The Santa Ana River is the principal drainage feature and flows to the southwest. Key tributaries include Lytle Creek Wash, San Timoteo Canyon, Etiwanda Creek, Deer Creek, Day Creek, and Mill Creek. Major creeks crossing Yucaipa include Wilson Creek, Oak Glen Creek, Wildwood Canyon, and others. Most of these drainages originate in the San Bernardino Mountains and flow in a southwesterly direction.

3. Flooding Hazards

3.1.5 ASSETS AT RISK FROM FLOODING

San Bernardino County has an extensive inventory of physical, cultural, biological, and other assets that could be damaged or destroyed during a flooding event. Assets at risk refer to people, property, and the environment that could be harmed during a flood. They can include life and safety; timber; rangelands for grazing; agricultural uses and crops; recreation; water and watershed; plants; air quality; cultural and historical resources; scenic areas; buildings; wildlife; and ecosystem health.

While the full range of assets at risk from flooding is not available, Table 3-2 presents a preliminary assessment of known assets at risk from major flood events. Additional information on assets at-risk from flooding can be derived from the 2016 San Bernardino County Hazard Mitigation Plan.

Table 3-2. Summary of Assets At Risk of Flooding

Asset	Relevant Areas	Description
Structures at Risk	Valley Mountains Desert	Structures in floodplains are exposed to a higher risk from flooding; approximately 95,000 structures valued at $13.3 billion and contents valued at $8.9 billion are at risk of damage due to flooding. Total depreciated value is estimated at $22.2 billion in structures and contents.
Agriculture and Croplands	Valley Mountains Desert	Although the county has limited cropland totaling 67,000 acres, approximately 16% of the acreage is exposed to 100- and 500-year floods, totaling approximately $10 million in assets.
Essential Facilities Exposed	Valley Mountains Desert	An estimated 160 essential facilities are in the 100- and 500-year flood zones. This total includes 135 schools, 12 fire stations, 9 police stations, and other facilities that serve as emergency response or evacuation facilities during a disaster.
High Potential Loss Facilities	Valley Mountains Desert	High potential loss facilities include hazardous materials sites and dams. The county has 11 dams and 70 hazardous material sites in the 100- and 500-year flood zones. No estimates are available for whether the dams are rated a high, significant, or low hazard.
Lifeline Utilities	Valley Mountains Desert	Lifeline utilities provide potable water, electricity, wastewater treatment, and communication services; 18 lifeline utilities are in the 100- and 500-year flood zones. Of particular note are 5 wastewater facilities, several gas and electrical facilities, and 7 communications facilities.
Transportation Infrastructure	Valley Mountains Desert	The county has significant transportation asset exposure, including 108 miles of railways, 16 miles of light rail, 230 miles of highways, 4 railroad facilities, 400 bridges, and 3 airports, among other transportation-related infrastructure that may be negatively impacted by flooding.
Cultural Resources	Valley Mountains Desert	The county has numerous cultural resources. Four Native American tribal areas covering 7,000 acres of land are in the 100 and 500-year floodplains. No estimates are available for archaeological, historical, or other locations where a site record has been filed.
Biological Assets	Valley Mountains Desert	Significant biological resources are at risk. These include 8 state-endangered or -threatened plants and 17 state-endangered or -threatened animals. Also included are 15 federally designated endangered and threatened plants, and 16 endangered or threatened animals.
Aesthetic and Recreational	Valley Mountains Desert	Since many parks and recreational resources are in floodplains and serve both recharge and flood control purposes, 100- and 500-year floods could severely degrade or destroy numerous recreational facilities with high aesthetics value countywide.
Water Quality and Aquatic Resources	Valley Mountains Desert	Mud and debris flows, particularly following wildfire, deposit significant amounts of metals and chemicals from burnt structures and fire retardant, ash, and excessive sediment into waterways that alter ecosystems and harm aquatic life.

Source: California Department of Water Resources, California Flood Future, 2010.

Figure 3-1 General Waterways

3. Flooding Hazards

This page left intentionally blank

3.2 FLOODING HAZARDS

San Bernardino County is subject to flooding hazards that could cause significant personal, property, and environmental damage. These flooding hazards are dam inundation, levee inundation, riverine flooding, urban flooding, and mud/debris flows. This section describes and illustrates these hazards.

3.2.1 DAM INUNDATION

Dam inundation results from the unintended release or surge of impounded water from a structure. The high-velocity and debris-laden wall of water released can result in significant casualties, economic loss, disruption of lifelines, and environmental damage. Dam inundation can result from dam collapse, damaged spillways, overtopping from prolonged rainfall, internal erosion, and other mechanical failures. These failures could result from structural deficiencies, lack of maintenance and repair, gradual weakening of the dam through aging, or weather events.

DWR tracks the hazard potential of 35 dam or basin facilities in San Bernardino County. In addition to one federal dam tracked by DWR (Mojave Dam), four federal dams could inundate the county. Headgate Rock and Parker dams span the Colorado River upstream between California (the county) and Arizona. Three other large dams—Davis, Glen Canyon, and Hoover—lie upstream between California (the county) and Utah on the Colorado River. Should these dams fail and downstream dams fail, the result could be catastrophic inundation along the Colorado River area in the county.

DWR classifies facilities using the Interagency Committee on Dam Safety hazard ratings based on the facility size and amount of water retained. According to DWR, San Bernardino County has 21 dams or basins with a high hazard potential, 9 with a significant hazard potential, 3 with a low hazard potential; 2 dams are not rated. Table 3-3 summarizes the hazard ratings for dams tracked by DWR and Table 3-4 lists each dam or basin facility.

Table 3-3. Hazard Rating Summary for Dam Inundation in San Bernardino County

Hazard Rating	Characteristics		Description of Dam Hazard Rating
	Number of Dams	Capacity (acre-feet)	
Low Hazard	3	1,066 af	**Low Hazard**. Failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
Significant	9	22,604 af	**Significant Hazard**. Failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, or disruption of lifeline facilities.
High	21	538,179 af	**High Hazard**. Failure or misoperation will likely cause loss of human life and would cause excessive economic loss to infrastructure, buildings, transportation systems, agriculture, and public utilities.
Not Rated	2	1,440 af	Several dam facilities have not received a rating from the Department of Water Resources. These water facilities are relatively small in size and are noted as basins in Table 3-4.
Total	35	563,289 af	

Sources: National Performance of Dams Program, 2015; and DWR, 2016.

3. Flooding Hazards

Table 3-4. Dams and Basins in San Bernardino County Tracked by DWR for Hazard Potential

ID	Dam/Basin Name	Drainage	Year Built	Storage (ac. ft.)	Owner	Primary Purpose	Hazard Potential
1	Alta Loma Basin 1	Alta Loma Channel	1964	70	SBCFCD	Flood Control	Significant
2	Alta Loma Basin 2	Alta Loma Channel	1971	85	SBCFCD	Flood Control	Significant
3	Bear Valley/Big Bear Lake	Bear Creek	1911	74,000	Public Utility	Irrigation	High
4	Cedar Lake	Talmadge Creek	1928	30	Private	Water Supply	Significant
5	Cedar Springs	West Fork Mojave	1971	75,000	State Govt.	Water Supply	High
6	Chino Ranch No. 1	Tonner Canyon	1918	137	Local Govt.	Irrigation	Low
7	Copper Basin	Copper Basin Wash	1938	22,000	Public Utility	Water Supply	Significant
8	Crafton Hills	Fairway Creek	2001	130	State Govt.	Water Supply	High
9	Cucamonga Debris Basin	Cucamonga Creek	1980	355	SBCFCD	Flood Control	High
10	Day Creek Debris Basin	Day Creek	1988	140	SBCFCD	Debris Control	High
11	Deer Canyon Debris Basin	Deer Creek	1980	24	SBCFCD	Flood Control	High
12	Demens Crk Debris Basin	Demens Creek	1980	35	SBCFCD	Flood Control	Significant
13	Devil Canyon Afterbay	Devil Canyon Creek	1995	850	State Govt.	Water Supply	Low
14	Devils Canyon Dike #1	Devils Canyon Dike	1934	79	SBCFCD	Water Supply	Low
15	Gene Wash	Gene Wash	1937	6,300	Public Utility	Water Supply	High
16	Glen Martin/Shadow Lake	Mtn. Home Creek	1950	33	Private	Water Supply	High
17	Grass Valley	Grass Valley Creek	1964	243	Private	Irrigation	High
18	Green Valley Lake	Green Valley Creek	1925	250	Private	Water Supply	High
19	Hickory Basin	W Fontana Channel	2008	220	SBCFCD	Flood Control	N/A
20	Jurupa Basin	San Sevaine Creek	2001	1,680	SBCFCD	Flood Control	High
21	Lake Arrowhead	Little Bear Creek	1922	48,000	Private	Irrigation	High
22	Lake Arrowhead (New)	Little Bear Creek	1976	1,970	SBCFCD	Water Supply	High
23	Lake Gregory	Houston Creek	1938	2,100	SBCFCD	Irrigation	High
24	Little Mountain	Devil Canyon Creek	1958	150	SBCFCD	Flood Control	Significant
25	Mineral Hot Springs Lake	Twin Creek	1967	37	Private	Water Supply	High
26	Mojave Dam/Reservoir	West Mojave Fork	1974	179,400	Federal	Flood Control	High
27	Perris Hill Reservoir	Offstream	1962	31	Local Govt.	Water Supply	High
28	Rancho Cielito	Chino Creek	1912	110	Private	Irrigation	Significant
29	San Sevaine Basin #5	San Sevaine Creek	2004	2,765	SBCFCD	Flood Control	High
30	Seven Oaks	Santa Ana River	1999	145,600	SBCFCD	Flood Control	High
31	Small Canyon	City Creek	1957	20	SBCFCD	Debris Control	High
32	Upland Basin	N/A	2008	1,220	Local Govt.	Flood Control	N/A
33	Yucaipa No. 1	Yucaipa Creek	1978	92	Public Utility	Water Supply	Significant
34	Yucaipa No. 2	Yucaipa Creek	1978	100	Public Utility	Water Supply	High
35	Yucaipa No. 3	Yucaipa Creek	1978	32	Public Utility	Water Supply	Significant

Sources: National Performance of Dams Program, 2015; and DWR, 2016.

In addition, three dams are in or near San Bernardino County that are not tracked by DWR but are evaluated by the USACE through its Dam Safety Action Classification (DSAC) system.

Prado Dam in Riverside County holds up to 61 billion gallons of water; its failure would inundate Chino and flow into Orange County. USACE assigned this facility a DSAC III rating (Moderate Urgency) due to its risk of embankment seepage, piping, and overtopping. Significant improvements to the dam and forebay have been implemented to improve and strengthen the dam. USACE will be completing interim risk reduction measures by 2020. Although it may not impact the county to a great degree, the Prado Dam could affect regional evacuation routes if the dam breached.

Prado Dam, California
Source: USACE

Additionally, San Antonio Dam in Los Angeles County drains approximately 27 square miles and its failure would inundate most of Upland. The USACE assigned the San Antonio Dam a DSAC II rating (High Urgency). San Antonio Dam received a DSAC II rating because of the potential for failure from foundation seepage and piping, failure of intake or channel walls, and failure from overtopping. As a result, USACE has developed a plan to implement the following Interim Risk Reduction Measures, or IRRMs. If needed, USACE will begin a Dam Safety Modification Study (DSMS) to be completed approximately 36 months after initiation.

The Mojave Dam drains 215 square miles of mountainous terrain south of Hesperia. Drainage is formed by the Deep Creek and West Fork Mojave River, which converge just above the dam. Built in 1971 to control flooding in desert communities, a worst-case scenario from failure of the Mojave Dam is that floodwaters would be expected to be confined to the existing Mojave River bed and the mouths of tributary channels. The facility is classified by a DSAC IV rating (Low Urgency) due to the potential for embankment seepage and piping. However, due to its remote location, USACE will not be implementing interim risk reduction measures.

Mojave Dam, California
Source: USACE

Figures 3-2a and 3-2b map the location of dams tracked by DWR and dam inundation paths in San Bernardino County. Those dam or basin facilities owned by the County of San Bernardino are highlighted with separate symbology.

3.2.2 LEVEE INUNDATION

Levee safety remains a concern in most regions of California, as evidenced by recent failures in the Sacramento and San Joaquin river basins that caused hundreds of millions of dollars in damages. Levee failure is the overtopping, breach, or collapse of a levee wall due to earthquakes that damage the walls, internal erosion of the levee banks, or poor engineering/construction or maintenance. However, levees most commonly fail due to significant water flows during storms, which may overtop levee sections, wash away the top portion of the levee, and create deep grooves that eventually expand and lead to the breach of the levee wall and the uncontrolled release of water.

USACE reports that there are 33 levee systems comprising 63 linear miles in San Bernardino County. Although the federal government built the majority of levees, the SBCFCD now owns and operates the vast majority of levees. The largest levees are in the Upper Colorado region near the Arizona border. The Bureau of Reclamation built four levees spanning 20 linear miles to provide protection from storm flow of the Colorado River and meet agricultural irrigation and water supply needs.

With respect to maintenance, the federal government maintains oversight of levees, but has no ownership or direct responsibilities for performing maintenance, except for USACE-operated levees. According to the National Inventory of Levees database, only one levee is rated in acceptable condition, 19 levees are rated in minimally acceptable condition, 8 levees are in unacceptable condition, and 5 are not rated. Table 3-5 summarizes basic information, including safety ratings, for levees in San Bernardino County. Table 3-6 lists each levee assessed by the USACE.

Table 3-5. Summary of Levees and Safety Ratings in San Bernardino County

Safety Rating	Basic Characteristics			Description of Levee Safety Rating
	Number of Systems	Length in Miles	Acres Protected	
Acceptable	1	0.2	11	Acceptable. While all the items may not be rated Acceptable, the levee system was assigned an "Acceptable" rating because no action is required in the recommendation other than to monitor.
Minimally Acceptable	19	24.7	17,877	Minimally Acceptable. Where one or more items are rated minimally acceptable or unacceptable, the unacceptable items would not prevent the system or segment from performing as intended during the next flood.
Unacceptable	8	17.4	4,742	Unacceptable. One or more system components are rated unacceptable and would seriously impair the functioning of the levee system, prevent it from performing as intended, and pose unacceptable risk to public safety.
Not Rated	5	21.4	12,378	

Source: USACE, National Levee Database, 2016.

The above summary and following tables only addresses the levees listed in the USACE Rehabilitation Inspection Program (RIP), most of which were constructed by USACE. There are additional levees that SBCFCD has constructed, but are not listed in the RIP. While the FEMA FIRM panels map these levees, little to no information is available regarding the condition of these facilities.

Figure 3-2a Dam and Basin Hazards - Countywide

3. Flooding Hazards

This page left intentionally blank

Figure 3-2b Dam and Basin Hazards – Valley and Mountain Regions

3. Flooding Hazards

This page left intentionally blank

Table 3-6. Levees in San Bernardino County Rated by USACE for Hazard Potential

Levee Name	Segment	Year Built	Length | Acreage	Sponsor	Safety Rating
Chino Creek 1	1	1961	1.52 mi | 162 ac	USACE	UNACC
Chino Creek 2	1	1961	1.48 mi | 232 ac	USACE	UNACC
City Creek 1	5	1960	2.97 mi | 1,583 ac	SBCFCD	UNAC
Cucamonga Creek 1	1	1977	0.53 mi | 8 ac	SBCFCD	MINACC
Cucamonga Creek 2	1	1978	0.61 mi | 54 ac	SBCFCD	MINACC
Cucamonga Creek 3	1	1984	0.26 mi | 34 ac	SBCFCD	MINACC
Cucamonga Creek 4	1	1984	0.78 mi | 142 ac	SBCFCD	MINACC
Cucamonga Creek 5	1	1977	1.15 mi | 79 ac	SBCFCD	MINACC
Cucamonga Creek 6	1	1978	0.98 mi | 37 ac	SBCFCD	MINACC
Cucamonga Creek 7	1	1984	0.33 mi | 21 ac	SBCFCD	MINACC
Cucamonga Creek 8	1	1984	0.23 mi | 82 ac	SBCFCD	MINACC
Colorado River - Beal	1	N/A	2.88 mi | 249 ac	US BOR	N/A
Colorado River - Nevada Extension	1	N/A	7.31 mi | 6,466 ac	US BOR	N/A
Colorado –Needles	1	N/A	3.15 mi | 339 ac	US BOR	N/A
Colorado - Nevada	1	N/A	7.02 mi | 5,182 ac	US BOR	N/A
Demens Debris Basin Collection Levee	1	1981	0.64 mi | 975 ac	SBCFCD	MINACC
Devil Creek Diversion	1	1958	1.36 mi | 935 ac	SBCFCD	MINACC
East Twin Creek 1	1	1961	2.11 mi | 1,072 ac	SBCFCD	MINACC
East Twin Creek 2	1	1961	1.66 mi | 351 ac	SBCFCD	MINACC
Lytle Creek (Muscoy Groin No. 4)	1	1956	0.78 mi | 233 ac	SBCFCD	UNACC
Lytle Creek (Muscoy)	1	1956	2.99 mi | 1,317 ac	SBCFCD	MINACC
Lytle Creek – Island Levee	1	1956	2.63 mi | 789 ac	SBCFCD	MINACC
Mill Creek	1	1960	5.7 mi | 5,028 ac	SBCFCD	MINACC
Needles "S" Street	3	1973	1.43 mi | 6,338 ac	SBCFCD	MINACC
Oro Grande Wash LB	1	-	0.23 mi | 82 ac	SBCFCD	MINACC
Oro Grande Wash RB	1	-	0.18 mi | 11 ac	SBCFCD	ACC
Quail Wash	1	1961	0.55 mi | 392 ac	SBCFCD	MINACC
Riverside 2	2	1958	3.87 mi | 1,659 ac	RCWFC&WCD	UNACC
Santa Ana River Right Bank SB	1	-	0.24 mi | 24 ac	SBCFCD	MINACC
Santa Ana River /San Timoteo Creek 1	1	1996	2.17 mi | 463 ac	SBCFCD	UNACC
Santa Ana River /San Timoteo Creek 2	1	1996	0.29 mi | 6 ac	SBCFCD	UNACC
Santa Ana River/Warm Creek	3	1979	4.29 mi | 405 ac	SBCFCD	UACC
Warm Creek 1	1	1956	1.08 mi | 259 ac	SBCFCD	MINACC

Source: USACE, National Levee Database, 2016.

3. Flooding Hazards

Valley Region

Levees provide protection for several communities in the Valley Region. A large portion of Rancho Cucamonga along the Day Creek and Cucamonga channels and areas bounded by the Etiwanda Creek Channel eastward to Cherry Avenue, and then extending southward to I-10 are protected by levees. This includes a significant portion of Fontana. While upstream dams do provide a measure of flood protection, downstream areas are protected by levees. Without levee protection, a 100-or 500-year flood could displace households and cause significant damage to residential, commercial, and industrial areas. The Muscoy and Devore areas are also protected with levees; failure would inundate those areas.

According to the National Inventory of Dams database and USACE, several levees in the Valley Region are in unacceptable condition and could lead to inundation if the levees fail during a storm. These include Chino Creek, City Creek, Lytle Creek, and the Santa Ana/San Timoteo Creek. Chino Creek 1 and 2 would flood areas east of the SR-71 in Chino, from El Prado Road to Big League Chino Hills Stadium. City Creek would flood areas at the corner of the SR-210 and SR-330 and southwest to the San Bernardino International Airport. Lytle Creek would flood the western portion of Muscoy. Finally, the Santa Ana/San Timoteo Creek area would flood areas at the intersection of I-215 and I-10.

Desert Region

In the Desert Region, the city of Needles and surrounding areas are protected by a series of levees built and maintained by the federal government. As part of the Colorado River Front Works and Levee System, the federal Bureau of Reclamation has been involved with the construction, rehabilitation, and maintenance of a system of dams and levees along the Colorado River, from Needles upstream to Davis Dam. However, if Parker, Davis, or Hoover Dam failed, portions of Needles would be inundated with floodwaters. CALOES encourages dam operators to maintain emergency action plans to mitigate the potential for damage from dam inundation.

Additional areas of the Desert Region protected by levees include areas around Barstow, the Marine Corps base, Newberry Springs, and Yermo. These levees are not included in the National Inventory of Dams database, although the SBCFCD shows that these levees are in operation. During inclement weather, the National Weather Service maintains a station at the Mojave River in Barstow that monitors river heights and crests that are most likely to overtop surrounding levees and cause damage to adjacent properties. The condition of these levees is unknown.

Figures 3-3a and 3-3b map the location of levees in San Bernardino County as provided by the USACE [note that this data is a service feature and is restricted, the data cannot be manipulated for labeling or formatting]. FEMA is currently modernizing mapping for the national levee system.

Figure 3-3a Levees – Countywide

3. Flooding Hazards

This page left intentionally blank

Figure 3-3b Levees – Valley and Mountain Regions

3. Flooding Hazards

This page left intentionally blank

3.2.3 RIVERINE FLOODING

Flooding is the most common natural disaster in San Bernardino County. A flood is a general and temporary condition of partial or complete inundation of normally dry land from overflow of inland or tidal waters, or unusual and rapid accumulation or runoff of surface waters, or mudflow, or the collapse or subsidence of land along the shore of a body of water due to erosion.

Flooding can be characterized in many ways—slow rise floods due to gradual inundation, flash floods due to intense storms, or debris flow floods in the hillsides. Many waterways in the Valley, Mountain, and Desert regions experience repetitive floods due to Southern California's topography, climate, and pattern of rural and suburban development.

Flooding in suburban areas of San Bernardino County can block access to residential neighborhoods.

San Bernardino County has established a Floodplain Safety (FP) Overlay District that identifies flood-prone areas largely consistent with floodplains determined by FEMA. As shown in Table 3-7, a significant portion of the county and critical assets are located within the County's FP1 and FP2 zones. No information is available for assets located within the FP3 zone.

Table 3-7. Floodplain Overlay Zones in San Bernardino County

Zone	Definition of Review Area	General Assets Exposed to Hazard	Critical and Sensitive Assets Exposed to Flooding Hazards
FP1	Refers to the 100-year flood used by FEMA to identify flood prone areas. Often called the 1% annual chance flood, or base flood, the 100-year flood has a 1% chance of being equaled or exceeded in any given year. The FP 1 contains zones: A, AE, AH, A1-30, and AO.	+ 120,000 acres (1%) + 41,024 residents + 116,367 structures + Value: $3.3 billion	+ Essential facilities: 30 (23 are schools) + 16 High Potential Loss facilities: of which 12 are hazmat sites and 4 are dams + 62 miles of highways and 124 bridges
FP2	Refers to the 500-year flood and includes areas that have a 0.2% chance of flooding in any given year. This includes areas between the limits of the 100-year and 500-year flood and certain areas subject to 100-year flooding. The FP2 includes FEMA-designated zones A-99 and the shaded Zone X.	+ 197,000 acres (2%) + 1,700,000 residents + 78,402 structures + Value: $7.5 billion	+ Essential facilities: 130 (112 are schools) + 65 High Potential Loss facilities, of which 58 are hazmat sites and 7 are dams + 167 miles of highways and 277 bridges
FP3	Refers to areas of undetermined, but possible, shallow flooding as determined by the County, Flood Control District, or other governmental entity. It does not refer to FEMA-designated Zone D, which is used for areas where there are possible but undetermined flood hazards and no analysis has been conducted.	Unknown	Unknown

Source: San Bernardino County Development Code (2016); Department of Water Resources, California's Flood Future Report, Appendix C: Analysis of Exposure to Flood Hazards by County in Attachment F: Flood Hazard Exposure Analysis (2014).

3. Flooding Hazards

Valley Region

At the base of the mountains, the urban valley can experience flooding in its narrow canyons and within the many unimproved creeks and interim channels. The densely populated urban valley region contains the headwaters of the Santa Ana River. Of particular flood concern is the Devore area, where the Cajon Wash and Lytle Creek converge and reach southward into Muscoy, and along the entire stretch of the Santa Ana River basin, from the mountains to its terminus at Prado Dam. This area also has significant territory within the 500-year floodplain. Large swaths of territory along the Santa Ana River and Mill Creek River in Highland, Mentone, and Yucaipa are also affected.

Flooding is evident in areas extending to and from the Cucamonga-Guasti Regional Park, covering an extended portion of Ontario. The 500-year floodplain is pronounced at the convergence of Deer Creek Wash and Cucamonga Creek at Guasti Regional Park, and then extends southward to the county line. Washes fed by drainage from the San Bernardino Mountains northeast of the I-215 and SR-210 in San Bernardino also fall within a 500-year floodplain. Drainage from the convergence of the Cajon Wash and Lytle Creek also create a 500-year floodplain, which flows southeasterly and terminates generally at the San Ana River near Loma Linda.

Mountain Region

The Mountain Region, though often the recipient of significant winter storms and intense rainfall, has limited areas designated by FEMA as located within the 100-year and 500-year floodplains. Due to its remote location, however, FEMA officials have not surveyed much of the Mountain Region. The most flood-prone areas are around Big Bear Lake, Baldwin Lake, Lake Arrowhead, and a few isolated areas. However, as discussed later, mountain communities at significant risk of debris/mud flows and flash floods include Forest Falls, Big Bear, Wrightwood, and others.

Desert Region

The Desert Region contains many steep mountain ranges that experience summer thunderstorms causing flash floods in many dry washes on the desert floor that collect in dry lakebeds. Because of the low-lying areas, flash flooding may wash out or erode roads, bridges, channels, and basins. With intense monsoon rainfall and low-lying areas with limited storm drainage systems, flooding also frequently occurs throughout the Desert Region in incorporated and unincorporated areas.

FEMA designates much of the Desert Region as Zone D, which classifies areas with possible but undetermined flood hazards or where no studies have been undertaken. The DWR has prepared awareness maps that identify areas where a 100-year floodplain may exist. The DWR awareness data identifies potential 100-year flood hazard areas in the High Desert region (e.g., Adelanto, Lucerne Valley, Johnson Valley) and remote areas in the Morongo Valley. Hinkley, Newberry Springs, Amboy, and Cadiz also have substantial areas within potential 100-year floodplains.

Figure 3-4 maps the 100-year and 500-year flood zones provided by FEMA and additional nonregulatory DWR awareness data that approximate additional 100-year flood hazard areas.

Figure 3-4 Flood Hazards

3. Flooding Hazards

This page left intentionally blank

3.2.4 URBAN FLOODING

Urban flooding is the inundation of land or property in a built environment, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. Although sometimes triggered by flash flooding or snowmelt, urban flooding is typically a repetitive condition that can happen regardless of whether or not affected areas are in designated floodplains or near any water body. Aside from the overflow of rivers and lakes, stormwater or water released from damaged water mains may accumulate on property and in public rights-of-way, seep through building walls and floors, or back up through plumbing. Urban floods can also wash away or cause extensive damage to roads, sidewalks, or vehicles.

Flooding in 2017 along the Cajon Pass causes a freeway segment to collapse, taking with it a fire engine

Flooding in 2017 along the Cajon Pass causes a freeway segment to collapse, taking with it a fire engine

Valley Region

Urban flooding is a concern across the Valley Region at the base of the San Bernardino National Forest. Seasonal monsoon rains in the foothills can send water southward, quickly bringing down vegetation and debris that can clog channels downstream. Most flood control infrastructure in cities was designed to accommodate a 25-year storm event within the general public right-of-way. Therefore, seasonal storms and periodic blockage of storm drains can quickly cause urban flooding and result in considerable damage to nearby homes and infrastructure.

Mountain Region

Mountain communities are also subject to urban flooding. Intense seasonal rainfall can activate seasonal streams and run unimpeded down hillsides. Urban flooding, mudflows, and debris flows are common from Wrightwood to Big Bear and to Forest Falls. Low-water crossings are common in mountain communities, resulting in seasonal road washouts. With the exception of drainage channels that parallel some of the major roadways, most of these communities lack complete storm drain systems, leading to urban flooding during or following seasonal storms.

Desert Region

Desert summer thunderstorms can also cause flash floods in dry washes on the desert floor. The water collects in dry lakebeds throughout the desert. Many highways do not have bridges but convey water across the road with dip crossings. Flash flooding can cause road and bridge wash outs and erosion of earthen channels and basins. Many of the desert communities also lack a complete storm drainage system. Because of the essentially flat terrain, seasonal monsoon rains can cause urban flooding in virtually every community, damaging homes, businesses, and infrastructure.

3. Flooding Hazards

No digitized maps are available on a countywide basis that detail the areas subject to urban flooding. The SBCFCD has prepared many storm drain master plans that address urban flooding. Table 3-8 identifies the County's flood control district zones and lists the applicable storm drain master plans. Some plans can be accessed at: http://cms.sbcounty.gov/dpw/FloodControl/Planning/MPD.aspx.

Table 3-8. San Bernardino County Flood Control District Zones

Zone	Location	Size of Area	Master Plans
Zone 1	The westerly portion of the San Bernardino Valley extending from Beech Avenue in the Fontana area to the Los Angeles County line, all south of the San Gabriel mountain range divide. This includes the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, and Upland, with the community of Etiwanda.	275 sq. miles	Master Plan of Drainage (MPD): Chino, Chino Hills, Etiwanda Area, Montclair, Ontario and New Model Colony, Rancho Cucamonga, San Sevaine, Upland Comprehensive Storm Drain Plan (CSDP): #1 (San Antonio), #2 (Cucamonga Creek)
Zone 2	The central area of the San Bernardino Valley, easterly of Zone 1 to approximately the Santa Ana River and City Creek demarcations. This includes Colton, Fontana, Grand Terrace, Highland, Loma Linda, Redlands, Rialto, and San Bernardino, with the communities of Bloomington, Del Rosa, Devore, and Muscoy.	318 sq. miles	MPD: Fontana, Reche CSDP: #3 (Rialto), #3 (Sierra, Fontana), #3 (Colton, Rialto), #7 (Cajon, Devore) Project 3-4 Bloomington - Crestmore
Zone 3	The easterly end of the San Bernardino Valley, east of Zone 2, which includes the cities of Highland, Loma Linda, Redlands, San Bernardino, and Yucaipa, with the community of Mentone.	366 sq. miles	MPD: Yucaipa CSDP #4 (Loma Linda/ Redlands), #5 (Live Oak Canyon), #6 (East Highland)
Zone 4	The Mojave River Valley from the San Bernardino Mountains to Silver Lakes. This includes cities/towns of Adelanto, Apple Valley, Barstow, Hesperia, and Victorville and portions of the communities of Baker, Baldy Mesa, Daggett, Desert Knolls, El Mirage, Helendale, Hinkley, Hodge, Lenwood, Oro Grande, Phelan, Pinon Hills, Silver Lakes, Spring Valley Lake, Wrightwood, and Yermo.	1,783 sq. miles	MDPs: Adelanto, Apple Valley, Barstow, Baldy Mesa, Desert Knolls, Hesperia, Phelan, Victorville
Zone 5	The mountainous watershed of the Mojave River on the crest and north slopes of the San Bernardino Mountains, including the communities of Arrowbear Lake, Blue Jay, Cedar Glen, Crestline, Green Valley Lake, Lake Arrowhead, Lake Gregory, Rimforest, Running Springs, Silverwood Lake, Skyforest, Snow Valley, and Twin Peaks.	163 sq. miles	CSDP: #5
Zone 6	The remainder of the county, including portions of the San Gabriel and San Bernardino mountains and the semidesert portion of the county. This includes the cities of Big Bear, Needles, Yucca Valley, and Twentynine Palms and the communities of Amboy, Joshua Tree, Lucerne Valley, Morongo Valley, Newberry Springs, and Trona.	17,200 sq. miles	MPD: Big Bear Lake, Moonridge-Rathbone Creek, Needles, Twentynine Palms, Yucca Valley

Source: County of San Bernardino, 2016.

3.2.5 ALLUVIAL FANS

An alluvial fan is a gently sloping, fan-shaped feature that is formed over time by successive runoff that deposits sediments beneath a steep mountain or canyon. Unlike river flooding that is confined within or adjacent to a channel, alluvial fan flooding is less predictable. Alluvial fan flooding is characterized by relatively shallow depths, high velocity, and moving soil and sediment, creating uncertainty about where rising water will travel. Alluvial fan flooding is highly subject to extreme rainfall, wildfire, mudslides, and other natural events. As described below, the Valley and Desert regions are most susceptible to flooding in areas characterized by alluvial fans.

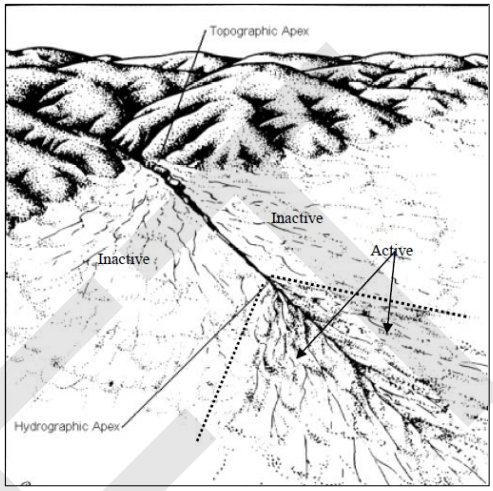


Illustration of alluvial fans and portions considered to be active and at risk of flooding.

Valley Region

The San Gabriel and San Bernardino mountains border the north side of the valley. Floodwaters have etched deep canyons, from which alluvial fans flow to the valley floor. In fact, the San Bernardino Valley was formed by a series of coalescing alluvial fans, of which the combined fan of the Santa Ana River and Mill Creek is the largest and most distinct. Alluvial fan areas subject to flooding are in Etiwanda, Rancho Cucamonga, Muscoy, San Bernardino, Fontana, and Highland. The Yucaipa and Oak Glen region near the base of the San Bernardino Mountains is also subject to alluvial fan flooding. The SBCFCD was created in response to the flooding event of 1938 by the state legislature via the San Bernardino County Flood Control District Act, adopted April 20, 1939.

Desert Region

The Desert Region is also marked by alluvial fans. Sheep Creek is an active alluvial fan that originates from Wrightwood in the San Gabriel Mountains and terminates 20 miles north at El Mirage dry lake with a total alluvial fan area that encompasses 85 square miles. Several fast-growing communities are located on or adjacent to an alluvial fan. Hesperia is at the base of the alluvial fan that forms the headwaters for the Mojave River. In addition, communities in the Mojave Desert (e.g., Yucca Valley, Joshua Tree, Twentynine Palms, and the Morongo Valley) are also on or adjacent to active alluvial fans. Alluvial fans and associated flooding hazards also extend to the outlying areas of Barstow and even to portions of Death Valley and the Mojave Desert that are not considered suitable for development.

In 2004, AB 2141 directed DWR to seek federal funding for an Alluvial Fan Task Force (AFTF) to develop a Model Ordinance and planning tools to mitigate flood hazards associated with alluvial fan flooding. In March 2007, the California State University, San Bernardino, Water Resources Institute was retained to develop the task force under the direction of DWR staff. Plans exist in the future to support an integrated approach for sustainable development on alluvial fans. No state or federal agency has produced official maps for alluvial fan flooding. However, the AFTF has produced maps of areas potentially containing alluvial fans for portions of the County: north, southeast, and southwest.

3. Flooding Hazards

3.2.6 DEBRIS AND MUD FLOWS

In 2014, heavy seasonal rainfall led to severe mud and debris flows in Forest Falls that shut down roadways.

A debris flow or mud flow is a form of slope failure and slippage, where a moving mass of loose mud, sand, soil, rock, vegetation, water, and air travels down a slope under the influence of gravity. It can form and accelerate quickly and reach high velocities, causing extensive damage to buildings, infrastructure, and roads. Typically, the source area of a debris flow must have: 1) a steep slope, 2) an abundant supply of loose debris, 3) a source of moisture, and 4) sparse vegetation. Debris and mud flows occur most frequently on hillsides that have little to no vegetation. Debris flows and erosion are most common following fires and have a history of occurrence in the foothills of the San Gabriel and San Bernardino mountains that front the Valley and Desert regions.

Desert Region

Several areas in the Desert Region are known to be susceptible to debris flows. Morongo Valley, the Sawtooth and Bartlett Mountains, Little San Bernardino Mountains, and Burnt Mountain are all subject to debris flows. Sediments forming the alluvial fans in this region are typically dry, loose, and sandy, resulting in a high susceptibility to erosion. Flooding due to infrequent but violent thunderstorms can result in severe erosion and debris flows in these areas, which run through natural washes and gullies. Smaller debris flows and sedimentation can occur at the foot of smaller hillsides. However, limited debris and mudflows have had a significant impact in the desert region.

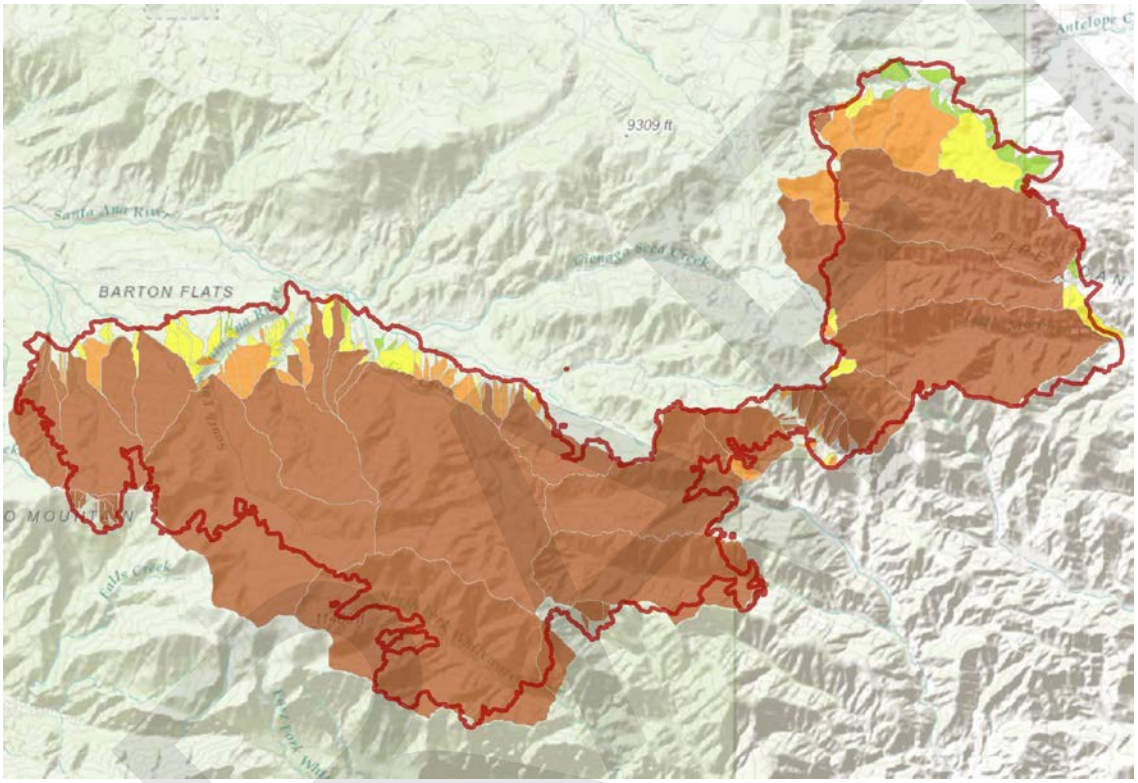
Valley Region

Although mudflows are less likely in urbanized areas, they still occur on a periodic basis. In 2010, Highland neighborhoods were inundated with mud following a severe rainstorm. The Dec. 22, 2010, floods were the worst in Highland's history. Days of rain, up to 10 inches in places, sent mud and water gushing down three creeks running through town. About 30 homes in a neighborhood known as the Village along Greenspot Road were buried in mud and declared uninhabitable. More than 200 residents were evacuated from their homes for several weeks.

Mountain Region

Debris and mudflows often occur in the Mountain Region, notably in Waterman Canyon (2003), Wrightwood (1969), and Forest Falls (1999). Forest Falls is frequently subject to debris flows; 11 mudslides destroyed property between 1955 and 1998. Moreover, in 2003, the Old Fire and Grand Prix Fire burned 250 square miles of land around Lake Arrowhead. USGS subsequently published a post burn analysis demonstrating the likely area for debris flows given the appropriate storm conditions. Winter storms and flooding the year following the fire led to debris flows and landslides that killed many vacationers in the San Bernardino Mountains.

A decade later, the Lake Fire (2015) burned 50 square miles in the San Bernardino National Forest. Following that event, USGS predicted that a 10-year storm could produce a debris flow exceeding 100,000 cubic meters, causing substantial loss to property, infrastructure, injuries, and life. USGS produced the following debris flow map for areas affected by the Lake Fire. The USGS assesses the potential for debris flows for selected fires and provides them online as budget permits.



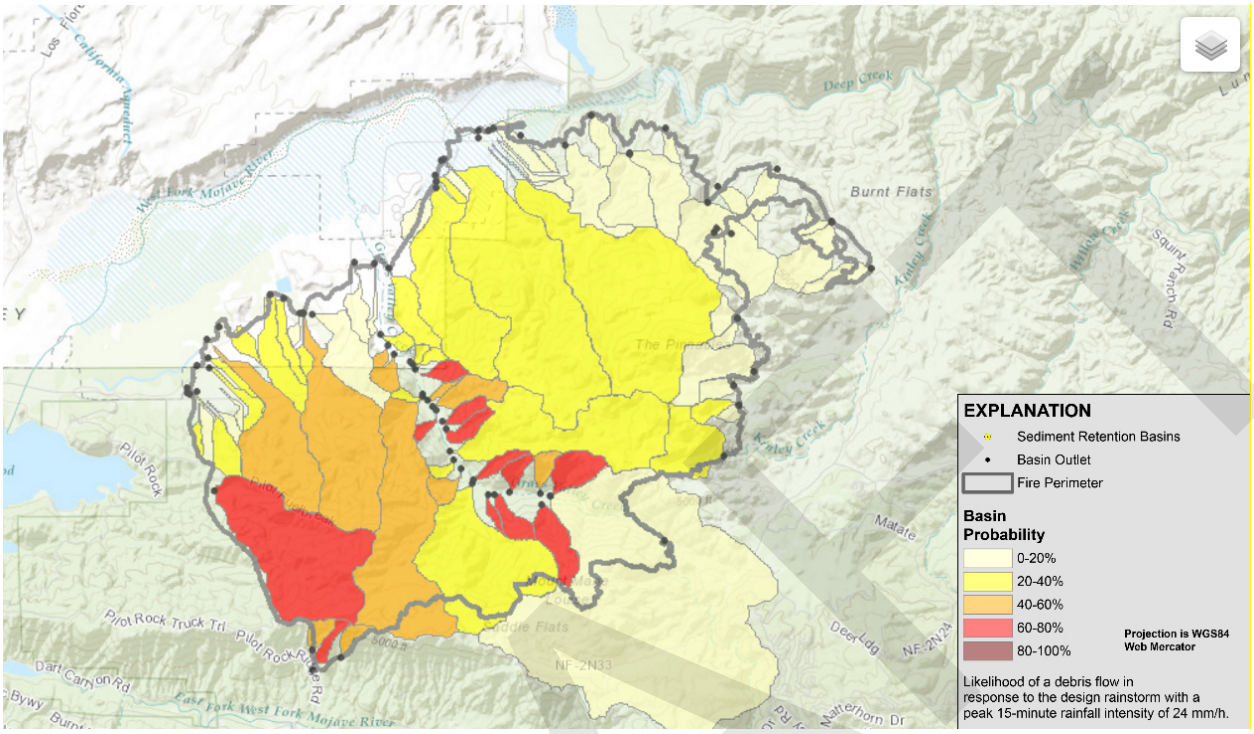
2015 Lake Fire - Preliminary Hazard Assessment

Basin Probability* 0-20% 20-40% 40-60% 60-80% 80-100% Fire Perimeter

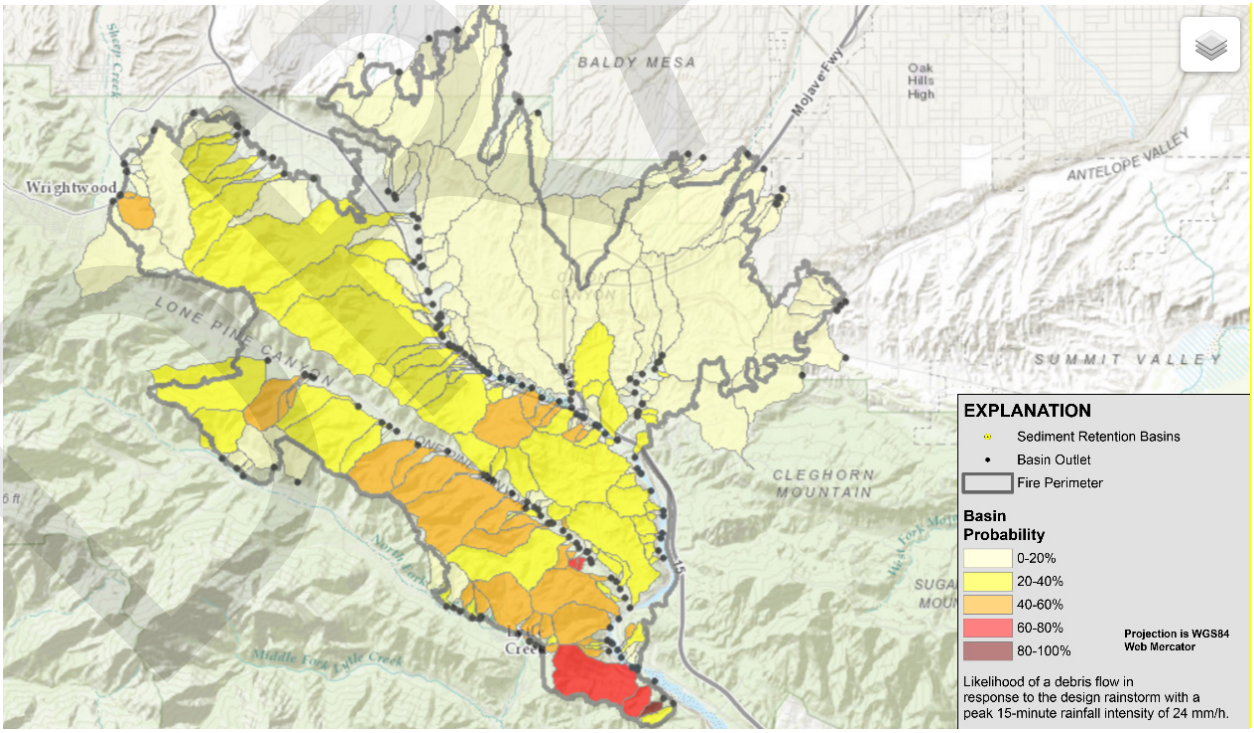
*Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mm/h.

Most recently, the Blue Cut Fire in 2016 burned 58 square miles in Cajon Pass and the High Desert, and the Pilot Fire in 2016 burned 13 square miles in the Miller Canyon area of Lake Arrowhead. To reduce the risk from hazards, the National Oceanic and Atmospheric Administration and USGS operate a flash-flood and debris-flow early-warning system for recently burned areas in southern California. The demonstration project utilizes the National Weather Service's Flash Flood Monitoring and Prediction system to identify when flash floods and debris flows are likely to occur based on radar precipitation estimates and established rainfall intensity-duration threshold values. Advisory outlooks, watches, and warnings are disseminated to emergency management personnel through the National Weather Service Advanced Weather Information Processing System.

3. Flooding Hazards



Preliminary Hazard Assessment for the Pilot Fire (2016)



Preliminary Hazard Assessment for the Blue Cut Fire (2016)

3.3 IMPLEMENTING AGENCIES

Federal, state, and local government agencies play different roles in managing risks from flooding due to flooding, dam inundation, and urban flooding. Key agencies are as follows.

Federal Emergency Management Agency

FEMA provides flood hazard mapping in the county and administers the National Flood Insurance Program (NFIP), which makes flood insurance available to communities that have enacted local floodplain ordinances restricting development within the 100-year floodplain, in accordance with FEMA regulations. As part of NFIP, FEMA prepares a Flood Insurance Rate Map delineating the theoretical boundaries of the 100-year floodplain. Cities and counties participating in the NFIP must require that new construction have its lowest floor elevated to or above the "base flood elevation" and keep records of development in designated floodplains. The county must submit a biennial report to FEMA describing any changes in its flood hazard area, development activities that have taken place in the floodplain, and the number of floodplain residents and structures.

US Army Corps of Engineers

The USACE and FEMA have different roles and responsibilities with respect to levees and dams. FEMA addresses mapping and floodplain management issues related to levees and accredits levees as meeting requirements set forth by the National Flood Insurance Program. The USACE is responsible for the maintenance and operation of the San Antonio, Prado, Seven Oaks, and Mojave River dams. The USACE has built the vast majority of levees throughout the nation and addresses risk management issues as part of its responsibilities under the Levee Safety Program. Presently, the USACE has turned over control of almost all its levees in San Bernardino County to local authorities for operations, maintenance, and repairs (Chino Creek is maintained by the USACE). In 2013, the USACE and FEMA developed recommendations for aligning agency processes so data collected for USACE inspections and projects are sufficient to satisfy NFIP accreditation requirements for levees.

California Department of Water Resources

The DWR Division of Flood Management collects climate data, conducts flood forecasting, plans flood emergency response activities, and coordinates collaboration between federal, state, local, and tribal governments related to flood events. Although many of the department's programs and studies focus on the most flood-prone areas of the state—such as the Sacramento/San Joaquin River delta in Northern California—some initiatives are relevant to the entire state. DWR's Division of Safety of Dams came into existence as a direct result of one of California's worst dam failures. DWR's Division of Safety of Dams reviews plans and specifications for the design of dams and oversees their construction to ensure compliance with the approved plans and specifications. Reviews include site geology, seismic setting, site investigations, construction material evaluation, dam stability, hydrology, hydraulics, and structural review of appurtenant structures.

3. Flooding Hazards

San Bernardino County Flood Control District (SBCFCD)

The SBCFCD has an extensive system of flood control and water conservation facilities, including dams, conservation basins, debris basins, channels, and storm drainage facilities. It exercises control over mainstreams in the county; acquires right-of-way for all main channels; constructs channels; and carries out an active program of permanent channel improvements in coordination with the USACE and other agencies. The principal functions of the SBCFCD are:

- **Flood Protection.** Conducts dam, channel, and levee construction, debris basin maintenance, floodwater retention, telemetry, storm watch, and master planning.
- **Water Conservation.** Operates and maintains basins and spreading grounds to facilitate groundwater recharge, protect the quality of groundwater, and other purposes.
- **Storm Drain Construction.** Active in storm drain master planning/construction and cooperates with incorporated cities and other agencies in storm drain projects.
- **National Pollutant Discharge Elimination System.** As lead permittee, the flood control district focuses on regulating stormwater quality for participating cities.

Flood Area Safety Task Force

The San Bernardino County Flood Control District works with County OES, Sheriffs and Fire on the Flood Area Safety Task Force (FAST) to coordinate efforts by cities, county, state, federal, and non-profit agencies to provide for the protection of property owners, residents, and property subject to the risk of erosion, mudflows and flooding that could occur in the county with an initial emphasis on the threat resulting from fires. The Flood Area Safety Task Force was formed following the 2003 fires that ravaged the county and impeded the delivery of critical regional services.

California Office of Emergency Services Dam Safety Program

The Cal OES Dam Safety Program was established by Government Code §8589.5 following a near failure of the Lower San Fernando Dam during the Sylmar earthquake. The Dam Safety Program provides assistance and guidance to local jurisdictions on emergency planning for dam failure events by collecting and reviewing inundation maps and evaluating waivers from the mapping requirements. Cal OES coordinates with the California Division of Safety of Dams and other state and federal agencies in activities to assure that effective emergency response procedures are in place to address potential dam incidents. The Program is also the designated repository of the official dam failure inundation maps used in California's Natural Hazard Disclosure statement for real estate transactions. Cal OES also encourages operators of high hazard dams to prepare emergency action plans that detail actions to be undertaken to protect public health and safety if a dam is threatened or compromised.

4. HAZARDOUS MATERIALS

This chapter addresses five topics: 1) introduction to hazardous materials; 2) governmental regulations that address these hazards; 3) an inventory of the varied hazardous materials and events in San Bernardino County; 4) mapping of hazards; and 5) organizations responsible for addressing them.

4.1 INTRODUCTION

Hazardous material management is essential to the safety of residents, business, and visitors in San Bernardino County. Hazardous material management refers to the appropriate regulation and control of any item or agent (biological, chemical, radiological, and/or physical) that has the potential to cause harm to humans, animals, or the environment by itself or through interaction with other factors. The county's waste management landscape is complex. The county is home to many waste landfills, Superfund sites, and businesses that manufacture, use, dispose of, or transport hazardous materials or waste products. Hazardous and toxic wastes are transported along freeways, railroads, and pipelines that span the county.

San Bernardino County firefighters extinguishing a dangerous fire that has engulfed a structure.

This chapter describes the existing conditions related to:

- Hazardous waste generation and storage in San Bernardino County
- Environmental protection from hazardous materials and wastes
- Hazardous waste transportation (highway, rail, and pipeline)
- Landfills and hazardous waste disposal

This chapter references publications from federal, state, and local agencies that identify and evaluate hazard materials threats. Federal agencies include the U.S. Environmental Protection Agency, Department of Transportation, and the Nuclear Regulatory Commission. State agencies include the Department of Toxic Substances and Control, Environmental Protection Agency, Department of Resources Recycling and Recovery, the Department of Health Services, California Highway Patrol, and the California Department of Transportation. San Bernardino County government agencies include the Fire, Public Health, and Public Works departments, among others.

4. Hazardous Materials

4.1.1 REGULATORY SETTING

The regulatory framework for hazardous waste management is complex. A broad range of federal laws, state laws, and local regulations govern the storage, use, transport, handling, and disposal of hazardous materials and waste. Pertinent legislation is summarized below.

Federal Laws and Regulations

Federal statutes and regulations set the framework for the majority of hazardous waste laws in place today, nationally and in California. Key federal laws and/or regulations are summarized below.

Resource Conservation and Recovery Act of 1976 as amended

The Resource Conservation and Recovery Act (RCRA) was enacted to protect human health and the environment from the potential hazards of waste disposal, conserve energy and natural resources, reduce the amount of waste generated, and ensure that wastes are managed in an environmentally sound manner. Federal hazardous waste laws are generally promulgated under the RCRA. These laws define hazardous waste, provide a cradle-to-grave system for tracking hazardous waste, and impose stringent requirements on facilities that treat, storage, and dispose of hazardous waste. The RCRA was amended by the Hazardous and Solid Waste Amendments of 1986, which phased out land disposal of hazardous waste, required stringent hazardous waste management standards, required a comprehensive underground storage tank program, and improved enforcement authority.

Comprehensive Environmental Response, Compensation, Liability Act of 1980 as amended

In 1980, Congress enacted CERCLA, known as Superfund, to identify and clean up the most hazardous waste sites that endanger public health and the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, required liability for persons responsible for releases of hazardous wastes, and established a trust fund to pay for cleanup when no responsible party is identified. CERCLA was amended by the Superfund Amendments and Reauthorization Act of 1986, which added minimum cleanup requirements and required that most cleanup agreements with polluters be entered in federal court as a consent decree. CERCLA also established the revision of the National Contingency Plan, which provides guidelines and procedures to respond to threatened release of hazardous substances, pollutants, or contaminants.

Clean Water Act of 1972 and National Pollutant Discharge Elimination System as amended

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. The CWA established the National Pollutant Discharge Elimination System (NPDES) to prohibit and, if permitted, regulate wastewater discharges from industries and wastewater treatment plants, known as a "point sources." In 1987, the federal Water Quality Act amended the NPDES permit to include "nonpoint-source" pollution to control the introduction of bacteria, sediment, oil and grease, heavy metals, pesticides, fertilizers, and other chemicals into rivers, lakes, bays, and oceans from nondiscrete sources.

Hazardous Materials Transportation Act of 1975 as amended

The HMTA is the principal federal law regulating the transportation of hazardous materials by ground, air, sea, or other mode of transportation. The HMTA was passed to improve uniformity of regulations for transporting hazardous materials and to prevent spills and illegal dumping that endanger life, property, and the environment, a problem exacerbated by uncoordinated and fragmented multiagency regulations. In accordance with the US Code, Title 49, regulations are enforced through uniform procedures and policies, material designations and labeling, packaging requirements, and operational rules. In 1990 and in 1994, Congress enacted the Hazardous Materials Transportation Uniform Safety Act for the purpose of further aligning the maze of state, local, and federal regulations affecting hazardous wastes and strengthening federal regulations.

Natural Gas Pipeline Safety Act (1968) and Hazardous Liquid Pipeline Safety Act (1979) as amended

The Natural Gas Pipeline Safety Act established the framework for regulating natural gas pipelines and safety laws managed by the USDOT Pipeline and Hazardous Materials Safety Administration. The act authorized USDOT to develop, prescribe, and enforce federal safety standards for the transportation of flammable, toxic, or corrosive natural gas by pipeline and the transportation and storage of liquefied natural gas. The Hazardous Liquid Pipeline Safety Act extended USDOT's authority to regulate transportation of hazardous liquids (crude oil, petroleum products, anhydrous ammonia, and carbon dioxide) by pipeline. Due to recent accidents, the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 established integrity management regulations for high and moderate consequence areas, maximum allowable operating pressures, and enhanced reporting requirements.

Toxic Substances Control Act of 1976 as amended

The Toxic Substances Control Act is the nation's primary chemical management law. It provides the EPA with authority to require reporting, record keeping and testing, and restrictions relating to a wide range of chemical substances and/or mixtures. Certain substances are generally excluded from the act, such as food, drugs, cosmetics, and pesticides. Historically, the program has had inadequate funding for the EPA to complete its mandate. On June 22, 2016, the Frank R. Lautenberg Chemical Safety for the 21st Century Act amended the Toxic Substances Control Act to create mandatory requirements for the EPA to evaluate existing chemicals with clear and enforceable deadlines; use new risk-based safety standards for identification of priority chemicals; increase public transparency for chemical information; and provide consistent funding for the EPA to implement the new law.

Emergency Planning and Community Right-to-Know Act of 1986

EPCRA was enacted to help communities protect public health, safety, and the environment from chemical hazards by requiring businesses to report the locations and quantities of chemicals stored. These reports help communities prepare to respond to chemical spills and similar emergencies. EPCRA requires manufacturers to report releases to the environment of more than 750 designated toxic chemicals; report offsite transfers of waste for treatment or disposal; implement pollution prevention measures and activities; and participate in chemical recycling. The EPA maintains a database of toxic chemical releases and other waste management activities reported by certain industry groups and federal

facilities. This online, publicly available database of chemical releases and activities is called the Toxics Release Inventory and was expanded by the Pollution Prevention Act of 1990.

California Laws and Regulations

California statutes and regulations set the framework for the majority of hazardous waste laws. Key state laws and/or regulations are summarized below.

California Hazardous Waste Control Act of 1972

California's Hazardous Waste Control Act of 1972 created the State of California's hazardous waste management program, which is similar to but more stringent than the federal RCRA program. In fact, the federal RCRA program was later modeled after California laws. The Hazardous Waste Control Law, codified in the California Health and Safety Code Section 25100 et seq., establishes standards for regulating the generation, handling, processing, storage, transportation, and disposal of hazardous wastes from "cradle to grave." The regulations are designed to create a tracking system for hazardous waste from the moment it is generated until it is recycled or discarded. To facilitate tracking, hazardous waste generators must complete a manifest that accompanies the waste from the generator to transporter to the ultimate disposal location. Despite its intent, however, concern has been expressed that inadequate oversight is provided to track all hazardous waste shipments.

Carpenter-Presley-Tanner Hazardous Substances Account Act

California's counterpart to the federal CERCLA is the Carpenter-Presley-Tanner Hazardous Substance Account Act (HSAA), which is codified in the California Health and Safety Code Section 25300 et seq. The HSAA is intended to provide a comprehensive scheme to ensure the timely and cost-effective cleanup of hazardous substance release sites to protect the health, safety, and welfare of the public. The HSAA establishes authority, procedures, and standards that are intended to: 1) carry out the investigation, removal, and remediation of contaminated sites; 2) issue and enforce a removal or remedial action and impose administrative or civil penalties for noncompliance of an order; 3) recover costs and expenses incurred by the DTSC in carrying out HSAA; and 4) implement other measures to protect and compensate the public from the release of hazardous wastes. Although both the California and federal statutes were enacted for the purpose of cleaning up contaminated "Superfund" programs, the cost of such cleanups has vastly outstripped the resources allocated to those programs.

Porter-Cologne Water Quality Control Act of 1969 as amended

The Porter-Cologne Water Quality Control Act, California Water Code Section 1330 et seq. and Title 23 of the California Administrative Code, is California's counterpart to the federal Clean Water Act. The Porter-Cologne Act is the principal law governing water quality regulation and establishes a comprehensive program to protect water quality and the beneficial uses of water. The act applies to surface waters, wetlands, and groundwater and to both point and nonpoint sources of pollution. The Porter-Cologne Act created the State Water Resources Control Board and nine Regional Water Quality Control Boards (RWQCBs) that are responsible for planning, permitting, and enforcement functions. The State Board formulates state policies for water-quality control and implements the stormwater quality permit system. Under the Porter-Cologne Act, the State Board and RWQCBs have promulgated

regulations affecting the design, construction, operation, and maintenance of underground and above-ground storage tanks to reduce causes of groundwater pollution.

Hazardous Waste Transportation Act

All hazardous waste transporters operating in California must adhere to a complex set of regulations that are designed to improve the safety of hazardous waste transport. Transporters must register with the DTSC and, unless exempted, must comply with the CHP regulations, the California State Fire Marshal regulations, and USDOT regulations. In addition, hazardous waste transporters must comply with Division 20, Chapter 6.5, Articles 6 and 13 of the California Health and Safety Code and Title 22, Division 4.5, Chapter 13 of the California Code of Regulations, administered by DTSC. Transporters handling hazardous waste of concern must report missing or unaccounted-for hazardous waste and provide a disclosure statement as part of their application for or renewal of annual registration for a permit to operate. Regulations to operate are summarized at www.dtsc.ca.gov/HazardousWaste/Transporters/upload/Hazardous-Waste-Transporter-Requirements.pdf.

Elder California Pipeline Safety Act of 1981 as amended

The Elder California Pipeline Safety Act, codified under Government Code Section 50001 to 57550, authorizes the Office of the State Fire Marshal (OSFM) to exercise jurisdiction over safety regulations for intrastate pipelines used for the transportation of hazardous or highly volatile liquid substances. The California Public Utilities Commission [CPUC] ensures that the state's natural gas and liquid petroleum pipeline systems are designed, built, operated, and maintained according to safety standards set by the CPUC and the federal government.) The act authorizes the OSFM to exercise safety regulatory jurisdiction over portions of interstate pipelines in the state and subject to an agreement with the US Secretary of Transportation. The act authorizes the OSFM to enter, inspect, and examine, at reasonable times and in a reasonable manner, the records and properties of any pipeline operator to determine whether the pipeline operator is in compliance with the act. Effective 2017, the OSFM is required to inspect all intrastate pipelines and operators of intrastate pipelines on an annual basis.

Medical Waste Management Act of 1996

The California Medical Waste Management Act (MWMA) is codified in the Health and Safety Code, Section 117600 et seq. Administered by the California Department of Health, the MWMA provides uniform regulation and a cradle-to-grave management of medical waste that could potentially transmit infectious disease. The MWMA regulates all aspects of the generation, handling, storage, treatment, transport, and disposal of medical waste. The MWMA requires that small and large medical waste generators, transporters, and disposal facilities be permitted by the authorizing jurisdiction prior to operation. Generators are required to prepare medical waste management plans detailing how waste is generated, segregated, handled, stored, packaged, treated, or shipped for treatment. Procedures are in place to enforce regulations or closure of facilities violating state law or their respective permits. AB333 (2014) was the first major overhaul of the MWMA since its enactment 20 years ago.

4. Hazardous Materials

Key Local Codes and Regulations

General Plan Policy

The San Bernardino County General Plan contains land use compatibility tables that rank specific land uses that are located or proposed to be located within areas with flooding, geologic, or seismic hazards. Land use compatibility is ranked in three categories—permitted, generally incompatible, and restricted. Hazardous materials/manufacturing, handling, or storage facilities are considered restricted uses in 100-year floodplains and fault hazard zones, restricted or generally unsuited in liquefaction zones, and least compatible in landslide susceptibility zones. Restricted is defined as a prohibited use unless alternative sites are not available or feasible and it is demonstrated through site investigation that, although mitigation may be difficult, hazards will be adequately addressed.

Additional general plan policies include guidance for siting hazardous facilities. Land use policies state that potentially polluting, hazardous, and other health risk facilities should be located no closer than one mile to a sensitive receptor and vice versa. Additional goals in the Safety Element prioritize separating certain types of hazardous facilities from sensitive land uses. This does not include landfills, medical waste generators, and other hazardous waste treatment facilities.

Hazardous Waste Overlay

The San Bernardino County Development Code (Section 82.16) sets forth a Hazardous Waste (HW) Overlay to ensure that hazardous waste facilities are sited in areas that protect public health, safety, welfare, and the environment, and buffer hazardous waste facilities so that incompatible uses cannot be permitted in the future, among other purposes. The HW Overlay shall be applied to areas where a hazardous waste facility is being approved.

- **Location**. The HW Overlay is only allowed in the Resource Conservation (RC) and Regional Industrial (IR) land use district. A risk assessment evaluating a proposal for a hazardous waste facility shall determine the appropriate location.
- **Siting Criteria.** Siting criteria for a hazardous waste facility is determined by policies in the Safety Element of the General Plan or Table 5-2 of the San Bernardino County Hazardous Management Plan.
- **Permitting.** A hazardous waste facility requires the concurrent filing of a general plan amendment and a conditional use permit. It also requires a special use permit from the fire department and ministerial permits from building and safety.

San Bernardino County also adopted its Hazardous Waste Management Plan in 1990. The plan identifies the types and amounts of hazardous waste generated in the county; establishes programs for managing these wastes; identifies an application review process for siting of specified facilities; identifies mechanisms for reducing the amount of waste generated; and identifies the goals, policies, and actions for achieving effective hazardous waste management.

4.1.2 IMPORTANT TERMS

The following important terms for hazardous material hazards are used in this section.

Hazardous Material

Hazardous material is "any material that because of its quantity, concentration, or physical or chemical characteristics poses a significant present or potential hazard to human health and safety or the environment." Substances that are flammable, corrosive, reactive, oxidizers, radioactive, combustible, or toxic are hazardous. Hazardous materials can be liquids, solids, or contained gases; the by-products of manufacturing; discarded used materials or discarded unused commercial products; or pesticides.

Hazardous Material Management

Hazardous material management refers to the appropriate regulation and control of any item or agent (e.g., biological, chemical, radiological, and/or physical) that has the potential to cause harm to humans, animals, or the environment by itself or through interaction with other factors. This term also includes the full range of hazard material management, which includes the generation, use, storage, recycling, transport, treatment, and ultimate disposal of hazardous material.

Hazardous Waste Generators

The EPA regulates hazardous waste generators to protect the safety of people, wildlife, and the environment. Regulations are based on the amount of hazardous waste generated: large quantity generators produce 1,000 kilograms per month or more of hazardous waste or more than 1 kilogram per month of acutely hazardous waste; small quantity generators produce 100 to 999 kilograms per month of hazardous waste. Hazardous waste is defined above and covers a broad list of materials and wastes.

Household Hazardous Waste

Household hazardous waste refers to postconsumer waste that qualifies as hazardous waste. These products may exhibit many of the same dangerous characteristics as fully regulated hazardous waste due to their potential for reactivity, ignitability, corrosivity, toxicity, or persistence. Examples of household hazardous waste include drain cleaners, oil paint, motor oil, antifreeze, fuel, poisons, pesticides, herbicides and rodenticides, fluorescent lamps, ballasts, smoke detectors, cleaning chemicals, and consumer electronics.

Incident

A hazardous material incident refers to a release of hazardous materials from a transmission pipeline or facility that may or may not result in death, injury, or damage to property or the environment. An incident connotes not only accidental hazardous materials release, but also broader events that occur deliberately or outside one's control. Typically, an incident of a certain threshold requires that the operator notify appropriate local, state, or federal regulatory authorities.

4. Hazardous Materials

Medical Waste

Medical waste means any biohazardous, pathology, pharmaceutical, sharps, trace chemotherapy, or trauma scene wastes not regulated by the federal RCRA of 1976, as amended. Medical waste is typically generated at health care facilities, such as hospitals, physicians' offices, dental practices, blood banks, veterinary hospitals/clinics, medical research facilities, and laboratories. A medical waste generator means any person whose act or process produces medical waste.

Medical Waste Generators

The Medical Waste Management Act considers any person whose act or process produces medical waste to be a "medical waste generator." This includes any facility or business that generates and/or stores medical waste onsite. Medical waste generators are classified into two groups—large- or small-quantity generators. A large quantity generator produces 200 or more pounds of medical waste per month; a small quantity generator produces less than 200 pounds of medical waste per month.

Pipeline System

A pipeline system is the system through which a hazardous liquid or gas is transported. It includes piping, valves, and other appurtenances, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations, and storage and breakout tanks. Although typically found underground, pipelines may also be found aboveground where operational considerations, environmental conditions, or geological concerns make it infeasible to underground the pipeline.

Sanitary Sewer Overflow

Sanitary sewer overflow is a condition in which partially or untreated sewage is discharged from a sanitary sewer system, wastewater plant, or holding pond into the environment. Sanitary sewer overflows often contain high levels of suspended solids, pathogenic organisms, toxic pollutants, nutrients, oil, and grease that can pollute surface and ground waters, threaten public health, harm aquatic life, and impair the recreational and aesthetic enjoyment of surface waters, streams, and rivers.

Superfund Site

A Superfund site is any land that has been contaminated by hazardous waste and identified by the EPA as a candidate for cleanup because it poses a risk to human health and/or the environment. These sites are placed on the National Priorities List (NPL). The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

Underground Storage Tanks

An underground storage tank system is a tank (or a combination of tanks) and connected underground piping having at least 10 percent of their combined volume underground. The tank system includes the tank, underground-connected piping, underground ancillary equipment, and any containment system. This definition does not include storage tanks aboveground.

4.1.3 RECENT HAZARDOUS MATERIALS INCIDENTS

San Bernardino County is subject to a wide range of incidents from the generation, use, storage, transportation, and disposal of hazardous waste. While many of these incidents are minor, unintended releases of hazardous materials due to natural events (e.g., earthquake, flooding) or accidents (e.g., pipeline ruptures or traffic accidents) can and have led to catastrophic results in urban and rural areas. Table 4-1 summarizes a select few of the more notable hazardous material incidents that have occurred in San Bernardino County over the past 25 years.

Table 4-1. Selected Hazardous Materials Incidents in San Bernardino County

Incident and Date of Occurrence	Location	Description
Train Derailment		
Train Derailment May 12 1989	Muscoy San Bernardino County	In 1989, a Southern Pacific train lost control while descending Cajon Pass, causing train to exceed 100 mph and derail within the Muscoy neighborhood. The crash caused 6 deaths and dozens of injuries, destroyed 7 homes and 69 rail cars, and required the replacement of railroad tracks and infrastructure. A pipeline rupture several days later (see below) led to additional damages in Muscoy. Total damages of the train derailment and pipeline rupture exceeded $14 million.
Train Derailment April 4, 2005	Rialto San Bernardino County	A train derailed within the City of Rialto that was transporting combustible liquid (naphtha) and chlorine in several tankers. Although the derailment did not result in accidental releases of hazardous materials, cleanup operations caused a subsequent release of combustible material which led to the evacuation of approximately 200 people from nearby structures. Damages to the railcars and UP railroad track totaled $600,000. The costs to clean up and remediate the spill are unknown.
Train Derailment September 11, 2010	Fontana San Bernardino County	A Union Pacific train struck a slower-moving train in Fontana. The slower train was hauling I-beams that pierced the locomotive of the faster train, trapping the engineer. Two railroad employees were injured and transported to local hospitals. One individual lost limbs due to the accident. The I-10 freeway was shut down until 500 gallons of antifreeze that leaked from the rail cars was cleaned up. Damages exceeded one million dollars, excluding medical costs.
Pipeline Breach		
Pipeline Explosion May 25, 1989	Muscoy San Bernardino County	The Muscoy pipeline explosion is the most severe incident in recent time. A 14-inch high- pressure petroleum pipeline near the site of the Muscoy train accident failed due, in part, to damage caused by train derailment and subsequent cleanup activities. The pipeline burst and showered a neighborhood with more than 300,000 gallons of flaming gasoline. The explosion killed 2 people, destroyed 11 homes and 21 cars, and caused $14.3 million in damage. This incident led to the passage of significant amendments of pipeline safety legislation in California.
Pipeline Leak Mountain Pass Mine 1984 through 1996	Mountain Pass San Bernardino County	For over a decade, a stretch of the Mojave Desert was contaminated with radioactive waste from a ruptured pipeline at the Mountain Pass Mine, a rare earth mine. An estimated 600,000 gallons of radioactive waste from spills leaked into and around Ivanpah Dry Lake, contaminating protected critical habitat for desert tortoises, a federally endangered species. After cleanup, lawsuits, and multiple attempts at reopening, Molycorp filed for bankruptcy protection in 2016.
Pipeline Leak Mojave River Pipeline November 21, 2004	Cajon Pass San Bernardino County	In 2004, a CAL-NEV 14-inch petroleum multi-product pipeline sprung a leak due to prior damage from a third-party use of construction equipment. The spill was on BLM lands set aside as habitat for the California desert tortoise. Soil sampling revealed that the site was contaminated with volatile organic compounds, benzene, hydrocarbons, diesel, xylenes, and other toxic substances. The cleanup required the removal of 10,300 tons of soil (362 truckloads).

4. Hazardous Materials

Table 4-1. Selected Hazardous Materials Incidents in San Bernardino County

Incident and Date of Occurrence	Location	Description
Tanker Incident		
Tanker Rollover May 6, 2000	Rialto San Bernardino County	A toxic acid spill forced closure of I-10 over a 20-mile stretch from Ontario to San Bernardino. A 30,000-gallon tanker truck carrying hydrochloric acid began spilling its load for unknown reasons. A chemical plume formed above the spill and began moving toward I-10. Rialto police evacuated about 100 people from 25 industrial businesses near the leak.
Tanker Rollover July 24, 2011	Daggett San Bernardino County	A truck carrying combustible diesel fuel overturned. Material lost totaled $1.2 million and remediation costs topped $19 million. Limited information is available about the cause of the truck rollover.
Tanker Rollover September 26, 2011	Angelus Oaks San Bernardino County	A tanker transporting gasoline overturned on Highway 38 east of Angelus Oaks. The tanker trailer transporting 8,200 gallons of gasoline ruptured, and a significant portion of the cargo escaped. Gasoline was diverted before seeping into the Santa Ana River. Below the highway near a private organizational camp, 12 individuals were safely evacuated until the situation was resolved.
Illegal Dumping		
Illegal dumping: 2000s	Multiple Locations San Bernardino County	The California Attorney General and three County prosecutors sued AutoZone chain for illegally dumping hazardous waste at many of its 410 California stores. Hazardous materials were illegally dumped into storm drains, and used oil and oil filters were improperly stored or removed. Hazardous waste materials were improperly sent to San Bernardino County landfills for disposal.
Illegal Dumping Dates back to 1940s	Rialto San Bernardino County	The Denova site in Rialto was used to store explosives and hazardous substances during World War II as well as railcars loaded with weapons. From the mid-1980s through 200s, the site operated as a chemical and explosives storage and disposal facility. In 2002, the EPA removed more than 550,000 pounds of abandoned hazardous materials and explosives at a cost of $3 million.
Illegal Dumping Dates back to 1940s	Rialto San Bernardino County	In 2012, the EPA reached settlement of $50 million with responsible parties to clean up the Rockets, Fireworks, and Flares Superfund site. This 160-acre site was the source of soil and groundwater contamination, including trichloroethylene and perchlorate, which resulted in the closure of numerous drinking water wells in the Colton-Rialto groundwater basin.
Water Contamination		
Groundwater Contamination 1950s–1960s	Hinkley San Bernardino County	A PG&E facility began operating in 1952 and discharged 370,000,000 gallons of untreated cooling tower wastewater containing hexavalent chromium into unlined ponds until 1964. Hexavalent chromium is now a known carcinogen. Cleanup costs alone are estimated to have exceeded $750 million. Hundreds of millions of additional dollars have been authorized to settle medical cost claims.
Sewage spill April 12, 2006	Victorville San Bernardino County	An 8.7-million-gallon spill of partially treated sewage occurred when Victor Valley Wastewater Reclamation Authority overfilled a percolation pond with wastewater that was largely cleaned but not disinfected. The wastewater spilled into the Mojave River, leading to a 50-foot breach and contamination of water along an 8-mile stretch of the river.
Sewage Spill December 22, 2010	Running Springs San Bernardino County	A winter storm washed out Little Mill Canyon where a sewer interceptor line was located. A large boulder crushed the concrete blanket and 400 feet of the main pipeline, spilling 6 million gallons of sewage. Sewer line repairs were delayed for several days due to the pipeline's inaccessibility in the canyon, hazardous weather conditions, and flooding.

Source: Various newspaper articles; state and federal publicly available databases.

4.2 POTENTIAL HAZARDS

California Government Code Section 65962.5 requires the DTSC to compile, maintain, and update lists of specified hazardous material release sites, called the "Cortese List." The California Environmental Quality Act (Public Resources Code Section 21092.6) requires the lead agency for a project to consult these lists to determine whether the project site and any alternatives are identified on the Cortese list. Today, the Cortese list refers to many databases that record hazardous materials.

Databases used include:

- **Toxics Release Inventory (TRI)**. TRI tracks certain toxic chemicals that may pose a threat to human health and the environment. Certain industrial facilities must report how much of each chemical is recycled, combusted for energy recovery, treated for destruction, and disposed. This information is collectively referred to as production-related waste managed.

- **EnviroStor.** EnviroStor lists sites that have known contamination or sites that merit further investigation. The database includes Superfund sites; state response sites, voluntary cleanup sites; school investigation and cleanup sites; corrective action sites; and tiered permit sites. It also includes sites under investigation for suspected but unconfirmed contamination.

- **GeoTracker**. Maintained by the State Water Regional Control Board, GeoTracker contains a listing of hazardous materials sites that could affect groundwater quality, including facilities permitted for underground storage tanks, leaking underground storage tank (LUST) sites, school cleanup sites, cleanup program sites, land disposal sites, and military sites.

Table 4-2 displays the number and general location of facilities in San Bernardino County known to generator, store, transport, or dispose of hazardous wastes. Given the nature of the databases, there may be some overlap (one site may be listed on more than one databases) between categories.

Table 4-2. Known Hazardous Material Activities in San Bernardino County

Type of Facility	Total Facilities	Region		
		Valley	Desert	Mountains
+ Facilities that reported toxic releases	102	78	24	0
+ Large quantity hazardous waste generators	398	289	99	10
+ Small quantity hazardous waste generators	2,011	1,621	352	38
+ Potential hazardous waste Superfund sites	73	48	24	1
+ Superfund sites on the Final National Priorities List	5	2	3	0
+ Hazardous Waste Transporters (vehicle)	73	63	9	1
+ Leaking Underground Storage Tanks	60	26	25	9
+ Formerly Used Defense Sites	55	6	49	0

Sources: EnviroStor, GeoTracker, and Toxic Release Inventory databases, 2016.

4. Hazardous Materials

4.2.1 TOXIC CHEMICAL RELEASES

Maintained by the EPA, the TRI tracks the management of certain toxic chemicals. In general, chemicals covered by the TRI Program are those that cause: 1) cancer or other chronic human health effects; 2) significant adverse acute human health effects; and 3) significant adverse environmental effects. Facilities that report to the TRI are typically involved in manufacturing, mining, electric power generation, chemical manufacturing, and hazardous waste treatment. Certain facilities must report annually how much production-related waste is recycled, combusted for energy recovery, treated for destruction, and disposed of or otherwise released on- and off-site.

In 2014, the amount of toxic chemicals production-related waste in San Bernardino County totaled 22 million pounds, nearly the same quantity produced in 2003, although the volume has significantly varied during the intervening years. It averaged 17 to 18 million pounds from 2004 to 2008 before falling to below 10 million pounds in 2010 and 2011. Since the economic recession ended, production-related waste has doubled in tonnage. Approximately 10 companies (primarily in the mining, cement, and steel manufacturing industries) make up 70 percent of the total tonnage of toxic chemical waste produced in San Bernardino County.

For toxic chemical production waste, the preferred management method is source reduction, where waste is minimized before it is even produced. If toxic waste is produced, the preferred disposition is recycling or reuse, followed by energy recovery, treatment, and as a last resort, releasing the waste to the land, air, and/or water. Since 2010, the percentage of toxic chemicals disposed of or released to the environment has declined, although the amount of waste treated for disposal has increased 25 percent. Table 4-3 details trends in Toxic Chemical Waste Disposition in San Bernardino County.

EPA hierarchy emphasizing preferred methods of toxic chemical waste disposition

Table 4-3. Toxic Chemical Waste Disposition in San Bernardino County, 2010–2014

Criteria	Year of Record				
	2014	2013	2012	2011	2010
Number of TRI Facilities	102	100	98	108	112
Production-Related Waste (lbs.)	21.1 million	19.2 million	11.7 million	9.6 million	9.7 million
+ Waste Recycled	33%	31%	52%	51%	56%
+ Energy Recovery	2%	4%	5%	6%	7%
+ Treatment	56%	56%	27%	27%	24%
+ Disposed or Other Release	8%	10%	16%	16%	13%

Source: TRI Explorer, April 2016.

4.2.2 SUPERFUND NATIONAL PRIORITY LIST

EPA's Superfund program is responsible for cleaning up the nation's most contaminated land and hazardous waste sites. In San Bernardino County, 73 hazardous waste sites are listed as Superfund sites, and 5 have been assigned to the final NPL, which lists the most contaminated sites requiring federal and state response. Table 4-4 summarizes the five NPL sites undergoing cleanup. More than $750 million will have spent by federal, state, and local authorities by the time cleanup is complete.

Table 4-4. Superfund National Priorities List Sites in San Bernardino County

Site Name	Description	Contamination
Marine Corps Base Barstow, CA NPL Listing Date: 11/21/1989	The base site of 5,687 acres consists of three areas: Nebo, Yermo, and the Rifle Range. The base provides equipment maintenance, repair, overhaul, and rebuilding, and receives, stores, maintains, issues and ships materials. 38 areas of contamination have been found.	Groundwater contains volatile organic compounds (VOCs) and solvents such as trichloroethylene (TCE) and perchloroethylene. Soil is contaminated with VOCs, pesticides, polynuclear aromatic hydrocarbons, heavy metals, and polychlorinated biphenyls (PCBs). + Cleanup costs to date (2013): $118 million + Addt'l cost to complete (2039): $43 million
George Air Force Base Victorville CA NPL Listing Date: 02/21/1990	George Air Force Base occupies 5,347 acres near Victorville and Adelanto. The base supported tactical fighter operations and training involving the use and disposal of a range of hazardous and nonhazardous materials. Site cleanup is ongoing.	Groundwater is contaminated with jet fuel, TCE, pesticides, and nitrates. Soil is contaminated with total petroleum hydrocarbons, dioxins, construction debris, medical wastes, pesticides, semivolatile organic compounds, and inorganic compounds. + Cleanup costs to date (2013): $177 million + Addt'l cost to complete (2014): $60 million
Newmark Contamination San Bernardino, CA NPL Listing Date: 03/31/1989	The Newmark groundwater contamination site underlies eight square miles of land in the northwestern and west-central portions of San Bernardino, around Shandon Hills and Muscoy. The contaminated area has been developed for light industry and residential uses. About 7.2 billion gallons of water per year is treated	Detection of the water contamination included chlorinated solvents, tetrachloroethylene (PCE), and TCE, resulting in the closure of 20 water supply wells in the Bunker Hills subbasin. ----- +The EPA and the City/County of San Bernardino entered into an $80 million settlement for cleanup
Norton Air Force Base San Bernardino, CA NPL Listing Date: 07/22/1987	Norton Air Force Base covers 2,165 acres and served as an overhaul center for aircraft. Past practices included burial of drums; disposal of waste oils, solvents, and paint residues into landfills, unlined pits, ponds, and drying beds; leaking underground tanks; spills of gas, oils, solvents, polychlorinated biphenyls, and acids.	Past TCE usage as a common degreasing solvent impacted the soil and upper water-bearing zone of a drinking water aquifer. Soil was also contaminated with dioxin, PCBs, and heavy metals including chromium, arsenic, and copper. + Cleanup costs to date (2013): $127 million + Addt'l cost to complete (2024): $17 million
BF Goodrich Rialto, CA NPL Listing Date: 09/23/2009	This 160-acre site was developed in the 1940s and used by multiple businesses. Activities included a military facility for rail cars transporting ordnance, defense contractors, fireworks manufacturers, and production of solid-fuel rocket propellant with ammonium perchlorate.	The soil and water are contaminated with VOCs, perchlorate, and other toxic substances. These contaminants have migrated more than 800 feet into the Colton-Rialto groundwater basin. ----- + Estimated cost of cleanup exceeds $100 million.

Sources: EPA, Superfund National Priority Sites, 2012

4. Hazardous Materials

4.2.3 FORMERLY USED DEFENSE SITES

Unexploded ordnance
Source: U.S. Army Corp of Engineers

Unexploded ordnance
Source: U.S. Army Corp of Engineers

San Bernardino County has a long history with the U.S. military, serving in multiple capacities as training grounds, testing grounds, storage/disposal facilities, manufacturing, and landing strips for the military. Many of these historical sites have contamination. As underdeveloped lands are considered for development or open space and recreational uses, public safety concerns arise. The public, visitors, and the environment could be exposed to unexploded ordnance, chemical releases, or other safety hazards that could cause injury, loss of life, or damage to the natural environment. It should be noted that former defense sites are a national concern, affecting thousands of sites nationwide.

San Bernardino County has 54 formerly used defense sites (FUD), which are sites transferred from the Department of Defense prior to 1986. To develop these sites will require evaluation and cleanup activities. Many FUD sites require cleanup for one or more conditions: 1) hazardous, toxic, and radioactive waste; 2) building demolition and/or debris; 3) military munitions and munitions constituents; and 4) containerized hazardous, toxic, and/or radioactive waste. FUD sites may also be contaminated with disposal sites and leaking underground fuel tanks. In addition, FUD sites often used ordnance (e.g., live munitions and explosives) that may not have detonated. While the majority of FUD sites are in the Desert Region, several are in the Valley Region.

FUD sites comprise a total of 258,000 acres, or just over 400 square miles of territory. According to the General Accounting Office, remediation costs range from $320 to $420 million. Many of the FUD sites have only received preliminary evaluations, although cleanup activities have commenced on a few sites. Like the NPL sites and other environmental cleanups of this nature, the likely cost for cleanup will be significantly higher. For more information on the location and extent of FUD sites, the USACE maintains a database and publicly accessible GIS mapping tool and database available at: www.usace.army.mil/Missions/Environmental/FormerlyUsedDefenseSites/FUDSGIS.aspx.

In 1996, Congress established the Army's Defense Environmental Restoration Program to provide for the cleanup of Department of Defense sites. The program actually consists of two programs. The Installation Restoration Program is designed to identify, investigate, and clean up hazardous substances, pollutants, and contaminants at active Army installations. The Military Munitions Response Program addresses nonoperational rangelands suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituents. The FUD Site Program was enacted to clean up environmental contamination at properties no longer under military use.

4.2.4 GROUNDWATER CONTAMINATION

Government agencies, the Regional Water Quality Control Boards, private responsible parties, and other stakeholders are working to address long-standing groundwater contamination in certain areas of San Bernardino County. Table 4-5 provides a brief summary of these plumes.

Table 4-5. Major Plumes in San Bernardino County

Site Name	Description
Hinkley Location: Hinkley Extent: 10,240 Acres	The Pacific Gas and Electric Company's (PG&E) Hinkley compressor station in the Mojave Desert is used to compress natural gas as it is transported through a pipeline from Texas to California. Between 1952 and 1964, cooling water used at the compressor station was treated with a compound containing chromium to prevent corrosion. The wastewater was discharged to unlined ponds, resulting in contamination of soil and groundwater in the underlying alluvial aquifer. The extent and migration of the plume continues to be under investigation.
Crafton-Redlands Location: Mentone Extent: 6,400 Acres	Two commingled plumes impact water supply wells for Riverside, Redlands, and Loma Linda. One plume contains trichloroethylene (TCE) and the other perchlorates; both are in the upper 300 to 400 feet of groundwater. TCE has been measured in water supply wells at over 100 parts per billion (ppb), over 20 times the maximum contaminant level established in state law. In addition, perchlorate is present in water supply wells at up to 77 ppb, nearly 10 times the maximum contaminant level. As required by the Santa Ana RWQCB, the Lockheed Martin Corporation has prepared and is implementing contingency plans to remediate the plumes.
Newmark/Muscoy Location: San Bernardino Extent: 5,120 Acres	Within San Bernardino, the Newmark and Muscoy plumes consist primarily of PCE. The plumes have impacted San Bernardino water supply wells. Under the Superfund Program, the EPA is cleaning up these plumes by extracting groundwater and treating it with granulated activated carbon. The treated water is used to supplement the City of San Bernardino's potable water supply. It appears that cleanup efforts will be adequate to protect 32 down-gradient water supply wells. However, groundwater model simulations suggest that containment of the plume will need additional extraction wells that will pump at least 14,000 acre-feet per year.
Fontana Location: Fontana Extent: N/A	Fontana Water Company operates and maintains a groundwater remediation project at its Plant F10 pursuant to a long-term agreement with San Bernardino County, the owner of the Mid-Valley Sanitary Landfill. Groundwater contamination is being addressed in accordance with a Cleanup and Abatement order issued by the RWQCB. The 5,000-gallons-per-minute treatment plant uses liquid phase, granular-activated carbon to treat for VOCs, including but not limited to PCE; TCE; 1,1-DCE; and cis-1,2-DCE. The plant treats contaminants from groundwater extracted from both the Rialto-Colton and No Man's Land subbasins.
BF Goodrich Location: Rialto Extent: 160 acres	The Santa Ana RWQCB is investigating a site in Rialto that was formerly used by a military facility for transporting ordnance, fireworks manufacturers, and for the production of solid-fuel rocket propellant with ammonium solvents. The soil and water is contaminated with volatile organic compounds, TCE, perchlorate, and nitrates. A Cleanup and Abatement Order has been issued that names a number of responsible parties. West Valley Water District (WVWD) and the City of Rialto have planned and designed a wellhead treatment system that uses fluidized bed biological treatment to break down perchlorate to chloride and nitrate to nitrogen gas.
Norton Air Force Base Location: San Bernardino Extent: 2,165 acres	Norton Air Force Base served as an overhaul center for aircraft. Past practices included burial of drums; disposal of waste oils, solvents, and paint residues into landfills, unlined pits, ponds, and drying beds; leaking underground tanks; and spills of gas, oils, solvents, polychlorinated biphenyls, and acids. The Norton Air Force Base plume consists primarily of TCE and perchloroethylene (PCE). The plume has impaired 10 wells in Riverside and San Bernardino. Cleanup efforts consisting of soil removal, soil gas extraction, and groundwater treatment have significantly reduced the plume's extent, so the treatment plants now operate in a standby mode.
Topock Location: Needles Extent: 70 + acres	In the 1950s, Pacific Gas and Electric operated a natural gas compressor station at the Topock site near Needles. Chromium compounds were used as a scale and corrosion inhibitors in cooling towers at the facility. Cooling tower wastewater was discharged to percolation beds, which eventually leaked in soil and groundwater. The plume of affected groundwater (containing mainly hexavalent chromium) lies beneath federally owned lands, and lands owned by PG&E, BNSF Railroad, and the Fort Mojave Indian Tribe. DTSC is the lead state agency overseeing the investigation and cleanup of the site. Information can be found online.

Source: California Regional Water Quality Control Board

4. Hazardous Materials

Underground Storage Tanks

Underground storage tanks (UST) are the tanks and pipes connected them that are used to store hazardous substances and are substantially or totally underground. Since the early 1980s, USTs have been recognized as a key cause of groundwater contamination from gasoline compounds and solvents. Statewide, the RWQCBs have been identifying cleanup requirements and abandoned leaking tanks, and promulgating regulations to protect groundwater and public health. The San Bernardino County Fire Department (SBCFD) is designated as the local Certified Unified Program Agency responsible for managing six hazardous waste management programs that include the UST program.

The County of San Bernardino has approximately 700 permitted tanks, as shown in Table 4-6. The total number of USTs that have been located, remediated, and closed may be as much as 1,000 based on a cursory review of the various UST databases. The Valley and Desert regions have the vast majority of permitted tanks and cleanup cases. Since 2012, the State Water Board has implemented a statewide program to identify and address improperly closed or abandoned underground storage tanks. Two-thirds of the 342 original sites have been resolved. In San Bernardino County, 23 of the 37 abandoned USTs have been remediated. Progress on this initiative can be found online.

Table 4-6. Underground Storage Tanks in San Bernardino County

Region	Compliance Status of Underground Storage Tanks			
	Permitted Tanks: Total in Operation	Leaking Tanks: Closed/Eligible for Closure	Leaking Tanks: Open Cases	Abandoned Tanks (all status)
Valley	671	657	26	N/A
Desert	284	277	25	N/A
Mountains	37	84	9	N/A
Total	992	1,018	60	N/A

Source: State Water Resources Control Board, GeoTracker database, 2016.

* The total number of UST sites cannot be determined by adding the respective totals for permitted USTs and leaking USTs. Due to database design, there is some overlap in the categories. There number of abandoned USTS is currently under investigation.

Since 2012, SBCFD has been working to address corrective actions required by RWQCB and DTSC. To date, four deficiencies have been corrected and six remain. Items identified for correction are 1) the lack of adequate documentation, 2) inconsistent follow-up for return to compliance businesses, 3) need for enforcement actions for abandoned USTs, 4) lack of consistent filing of hazardous materials business plans, 5) inconsistent inspections of aboveground petroleum tanks, and 6) improperly issuing UST operating permits to noncompliant facilities. SBCFD is reporting on progress to appropriate state agencies every 90 days until all deficiencies are resolved. Progress in compliance with the aforementioned state mandated requirements can be accessed online.

4.2.5 RADIOACTIVE WASTE

Radioactive waste is generated from the nuclear weapons program, commercial nuclear power, medical applications, mining, and corporate- and university-based research programs. Radioactive waste is generally categorized as high-level radioactive waste (HLRW) and low-level radioactive waste (LLRW). HLRW typically includes spent fuel from nuclear reactors. LLRW contains irradiated tools, lab clothing, ion exchanger resins, and trash from defense, commercial nuclear power, medical, and research. These materials have radioactivity that have shorter half-lives—from multiple days to several hundred years.

California law requires that all businesses that generate, store, transport, or store LLRW provide detailed information to the California Department of Health Services. The department is required to prepare annual reports summarizing the type of generator; county of generation; and the nature, characteristics, and quantities of LLRW generated. LLRW can be classified into three different classes based on the waste's concentration, half-life, and types of radionuclides. These classes and the amount generated in San Bernardino are:

- **Class A.** This LLRW makes up 95 percent of all LLRW generated statewide. Class A consists of radionuclides with the shortest half-life and lowest concentrations; its radioactivity returns to background levels in 100 years. About 3.5 cubic meters of LLRW was generated in 2012.
- **Classes B and C.** This LLRW contains greater concentrations of radionuclides with longer half-lives, fading to background levels in less than 500 years, and thus must meet stricter disposal requirements. Countywide, no Class B or Class C LLRW was generated in 2012.
- **Greater than Class C.** This LLRW makes up less than 1 percent of all LLRW generated in California and is the responsibility of the US Department of Energy under federal law. In San Bernardino County, no LLRW greater than Class C was generated in 2012.

Some LLRW generators will store waste to allow its radioactivity to diminish to levels that permit disposal as nonradioactive waste (i.e., storage for decay). Typically, LLRW in storage for decay is normally held for 10 half-lives or until radioactivity has diminished to a level indistinguishable from background radiation. As of 2012, San Bernardino County has 12.7 cubic meters of Class A low-level radioactive waste in the county. The latest Department of Health Services annual report reports that there is no Class B, Class C, or greater than Class C radioactive waste stored in the county.

With the passage of the Low-Level Radioactive Waste Policy Act of 1980, Congress declared that each state should be responsible for arranging disposal for the LLRW generated within its borders. In the southwest, the Southwestern Low-Level Radioactive Waste Disposal Compact formed to develop a disposal facility. During the 1980s to 1990s, multiple attempts were made to approve a LLRW disposal facility in Ward Valley. After considerable controversy, the proposal was defeated. Commercial low-level radioactive waste is now disposed of at one of four operating facilities: in Richland, Washington; Clive, Utah; Barnwell, South Carolina; and recently opened Andrews, Texas.

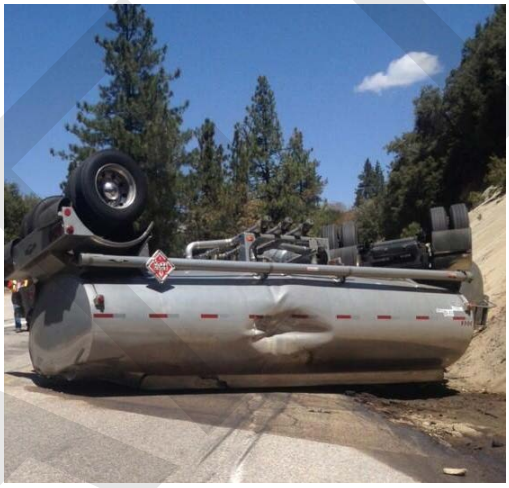
4. Hazardous Materials

4.2.6 HAZARDOUS MATERIAL TRANSPORT

San Bernardino County's highways, railroads, and pipelines are frequently used to transport hazardous materials. These include gasoline, chemicals, crude oil, and hazardous liquid products. These modes of transportation present potential hazardous conditions to people, property, and the environment should an accident occur in the loading, unloading, and transport of hazardous materials.

Highway Transportation

Highway transportation is the leading cause of hazardous material incidents in San Bernardino County. Tens of thousands of transports are made each year. According to USDOT, 3,240 incidents in hazardous waste transportation were reported from 2000 to 2015, which is approximately 200 highway incidents annually. These incidents caused an estimated $25.7 million in property, cleanup, and personal injury damage. Hazardous transportation incidents on roads involve the transport, storage, unloading, and loading of materials. About 50 percent of the incidents occurred during the transportation phase, with the remainder during unloading/loading or storage of materials.



Tanker truck rollover at Barton Flats on Highway 38 spills hazardous materials onto the road and down a canyon.

Tanker truck rollover at Barton Flats on Highway 38 spills hazardous materials onto the road and down a canyon.

PHMSA defines "serious incidents" as incidents that involve: 1) a fatality or major injury caused by the release of a hazardous material; 2) the evacuation of 25 or more persons; 3) a release or exposure to fire which results in the closure of a major transportation artery, 4) the release of certain radioactive materials; or 5) the release of over 11.9 gallons of a severe marine pollutant or a hazardous material. Only 33 (or 1 percent of all incidents) were deemed serious, and none involved radioactive materials. These incidents caused 5 injuries, evacuation of 36 people, and $23.6 million in damages. However, damages from transportation incidents involving hazardous materials are often underestimated; surveys show that actual costs of serious incidents are two to four times higher than reported.

Transporters

State law requires that hazardous waste be transported by a California-registered hazardous waste transporter. Registration requirements include a valid Hazardous Waste Transporter Registration, public liability insurance, compliance with California Vehicle Code registration regulations, and compliance with other Title 22 requirements. The CHP and Caltrans are responsible for enforcing federal and state regulations affecting hazardous waste haulers and responding to hazardous materials transportation emergencies on public roads. Drivers must carry detailed material data sheets for substances on board to help emergency response personnel assess the situation immediately upon arrival at an accident scene and take appropriate precautionary and mitigation measures. According to DTSC, 73 businesses in San Bernardino County are licensed to transport hazardous waste.

Hazardous Waste Routes

The CHP is also responsible for designating state and federal roads as hazardous materials routes. For transportation purposes, hazardous materials are grouped into three categories: explosives (Class B), inhalable poisons (Class I), and radioactive material (Class P). The National Hazardous Materials Route Registry lists all designated and restricted road and highway routes for the transportation of highway-route-controlled quantities of radioactive materials and nonradioactive hazardous materials. Table 4-7 shows the primary hazardous waste transportation routes. A complete list can be found from USDOT's online registry.

Table 4-7. Hazardous Waste Transportation: Major Routes in San Bernardino County

Route Description	Route Designation	Designations
Interstate 15, from Nevada to SR-60 (Mira Loma)	HRCQ/RAM | NRHM	P, B, I
Interstate 40, from Arizona to Barstow	HRCQ/RAM | NRHM	P, B, I
Interstate 10, from Arizona through County	HRCQ/RAM | NRHM	P, B, I
Interstate 215, from I-15 San Bernardino to Murrieta	NRHM only	B
State Route 60, from Los Angeles County to Beaumont	NRHM only	B, I
US -395, from Bishop to Interstate 15 (Hesperia)	NRHM only	B, I
State Highway 138, from Interstate 5 to I-15 (Cajon Junction)	NRHM only	B
State Highway 71, from I-10 to Corona	NRHM only	B
State Highway 18, from Llano to (US 395) Adelanto	NRHM only	B
State Highway 127, Nevada to Interstate 15 (Baker)	NRHM only	B
State Highway 247, from Lucerne Valley to Yucca Valley	NRHM only	B
State Highway 58, from State 14 (Mojave) to I-10 (Barstow)	NRHM only	I
Lenwood Rd. from State 58 to Interstate 15	NRHM only	I
Fort Irwin Rd. from Interstate 15 to Fort Irwin	NRHM only	I
National Trails Hwy/State 66 from Interstate 40 [Ludlow] to Interstate 40	NRHM only	I

Source: for a complete listing, see Federal Register / Vol. 80, No 82/Wednesday, April 29, 2015.
https://www.federalregister.gov/articles/2014/07/14/2014-15861/national-hazardous-materials-route-registry#t-16
HRCQ/RAM = highway-route-controlled quantities of radioactive materials
NRHM = nonradioactive hazardous materials

According to the draft program EIR for the 2016 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), container traffic is anticipated to triple over the life of the plan (up to 2040). Although the fraction of containers that carry hazardous material is not known, if it remains constant, transport of hazardous materials would be expected to triple as well. Similarly, hazardous materials transported via company trucks (e.g., gas companies that transport gasoline) and various industrial users transporting materials for their businesses (raw materials and waste products, etc.) would be expected to increase shipments proportional to business growth in the region.

Although hazardous materials transport is highly regulated, it will nonetheless remain a concern given San Bernardino County's role as a logistic hub and inland port for southern California and the nation.

4. Hazardous Materials

Railroad Transportation

Photograph of train derailment, explosion, and chemical spill that occurred from a train descending the Cajon Pass.

Railroad transportation can also be a source of hazardous material incidents in San Bernardino County. According to the USDOT, 796 hazardous materials incidents were reported on railroads from 2000 to 2015, or 50 annually. These incidents caused a total of $1.7 million in property damage. The vast majority of incidents were in Barstow, Bloomington, Colton, San Bernardino, and Fontana. These incidents involve the transport, storage, unloading, and loading of hazardous materials. Approximately 95 percent of hazardous material incidents during railroad transport occurred during the transportation phase rather than during loading/unloading or another process.

PHMSA defines "serious incidents" as incidents that involve: 1) ◦a fatality or major injury caused by the release of a hazardous material; 2) the evacuation of 25 or more persons; 3) a release or exposure to fire which results in the closure of a major transportation artery, 4) the release of certain radioactive materials; or 5) the release of over 11.9 gallons of a severe marine pollutant or a hazardous material. During the last 15 years, 20 incidents were "serious" causing several fatalities and injuries, evacuations, and one-third of reported damages. As is the case with most transportation-related incidents, questions remain as to the accuracy of railroad accident data, which led in part to the passage of the Rail Safety Improvement Act of 2008.

With the increase in domestic oil production and number of hazardous material incidents, the PHMSA, in coordination with the Federal Railroad Administration, issued a final rule in April 2015 clarifying the movement of flammable liquids by rail, including crude oil and ethanol. The final rule includes new operational requirements for high-hazard flammable trains transporting a large volume of Class 3 flammable liquid. Requirements included enhanced railroad tanker car standards and an aggressive, risk-based retrofitting schedule for older railroad tank cars, new braking standards, new operational protocols for transporting materials, and other procedural changes.

CPUC has noted several railroad safety concerns. San Bernardino County had 590 near-miss incidents in 2014—the second highest total of all counties in California. Near misses are defined as any uncontrolled train movement that threatens public health and safety. Second, the CPUC does not have an inventory of railroad bridges, and only one federal rail administration inspector is charged with the safety of railroad bridges in California. Finally, the CPUC reports a concern the inconsistency and underreporting of railroad incidents to the Office of Emergency Services and CPUC regulators. More information on other safety issues can be found in the Annual Railroad Safety Report to the California State Legislature, November 30, 2015, for FY2014-15, compiled by the CPUC.

Pipeline Transportation

Photograph of pipeline rupture

San Bernardino County is traversed by transmission and gathering pipelines for natural gas and hazardous liquid. Most pipelines are in rural and unpopulated areas. As of 2015, 10 major companies own and operate pipelines that stretch from the Valley Region to Nevada. Since 2010, 12 pipeline incidents have occurred, resulting in $5.2 million in damage. However, like other transportation incidents, many accidents and discharges to the environment may also be unreported. Regardless, as San Bernardino County develops, subdivisions will eventually be built closer to existing and planned routes for pipelines.

The consequences of pipeline accidents depend on the commodity released and the surrounding area. Since natural gas consists of 95 percent methane, a pipeline accident can cause an immediate fire or explosion and environmental damage (methane is a major greenhouse gas). Hazardous liquids (e.g., petroleum, natural gas liquids, and ammonia) present a wider range of effects. Propane releases can pose an acute hazard of fire or explosion, and gasoline and crude oil have acute and long-term consequences. Certain products can also have possible toxicity and asphyxiation effects. Some releases can cause environmental damage, harm wildlife, or contaminate drinking water supplies.

Pipelines are subject to a complex regulatory framework. The Federal Energy Regulatory Commission exercises exclusive jurisdiction over the permitting interstate natural gas pipelines. In contrast, interstate crude oil pipelines undergo a state-by-state siting approval process, and federal law does not preempt local law. Local agencies may have a larger role in the regulation, permitting, and siting of *interstate* hazardous liquid pipelines because no federal agency preempts local control. Finally, no federal or state law preempts County regulations for intrastate natural gas and hazardous liquid pipelines. San Bernardino County Development Code allows pipelines in virtually every land use designation without a conditional use permit when appropriate procedures are followed by state and federal agencies.

Federal and state regulations require enhanced integrity management is required for pipelines that cross "moderate" or "high" consequence areas, which include more densely populated areas or areas with buildings that are difficult to evacuate (e.g., prisons, schools, hospitals), and areas where larger groups of people might assemble. High consequence areas for hazardous liquid pipelines include populated areas, ecologically sensitive areas, drinking water sources, and waterways. New federal regulations also address maximum operating pressures and testing of pipelines for iron, bare steel, and Aldyl-A polyethylene pipes susceptible to failure, an unknown amount which is also in the county.

The location of crude oil, natural gas, and hazardous liquid pipelines in the county can be seen on the National Pipeline Mapping System Public Viewer at: https://pvnpms.phmsa.dot.gov/PublicViewer/.

4.2.7 SOLID WASTE DISPOSITION

Solid waste disposal is the last step in the waste management process. Sources of municipal solid waste include residential, commercial, institutional, and industrial activities. CalRecycle and the County Public Works Department regulate the operation of solid waste facilities by enforcing compliance with regulations through permitting, inspection, and enforcement.

Solid Waste Facilities

San Bernardino County has 180 solid waste facilities that accept, process, transfer, and dispose of municipal waste, tires, construction debris, green waste, biosolids, contaminated soil, metals, and other wastes. Shown in Table 4-8, solid waste facilities can be classified into five categories. Figure 4-1 maps waste disposal and landfill sites in San Bernardino County.

- **Composting Site.** Includes sites where the controlled biological decomposition of organic wastes is separated from municipal solid waste at the source or a facility. "Compost" includes vegetable, yard, and wood wastes that are not hazardous wastes.
- **Engineered Municipal Solid Waste Conversion Site.** Includes facilities that convert municipal solid waste into energy and fuel, allowing for the reduction of fossil fuel use, and that meet certain restrictions in accordance with the Public Resources Code (PRC § 40131.2)
- **Transfer and Processing Site.** Includes facilities that receive solid wastes; temporarily store, separate, convert, or otherwise process the materials in the solid wastes; or transfer solid wastes directly from vehicles for transport to other facilities.
- **Waste Tire Site.** Includes all places, locations, tracts of land, areas, or premises where waste tires are or will be stored, stockpiled, accumulated, discarded, collected, or processed. Waste tire sites include waste tire facilities, waste tire locations, and other locations.
- **Disposal Site.** Includes the place, location, tract of land, area, or premises in use, intended to be used, or which has been used for the landfill disposal of solid wastes.

Table 4-8. Solid Waste Facilities in San Bernardino County

Category Type	Facility Status				Total
	Active	Closed	Inactive	Planned	
Composting	35	2	–	4	41
Disposal/Landfill	14	71	2	–	87
EMSWC	–	–	–	1	1
Transfer & Processing	46	–	1	3	50
Waste Tires	1	–	–	–	1
Total	96	73	3	8	180

Source: Solid Waste Information System (SWIS) facility database, 2016.

Solid waste landfills often raise three primary concerns: subsurface migration, surface emissions/air pollution, and odor nuisance. Landfill gas can move underground to other areas inside or outside the landfill property. Most subsurface migration occurs at older, unlined landfills due to minimal barriers for lateral migration. While newer landfills have installed barriers to prevent migration, older landfills must be monitored for subsurface migration. Landfills can also produce landfill gases that contain carbon dioxide, methane, VOCs, and hazardous air pollutants that can adversely affect public health and the environment. Finally, landfill gas can produce strong, pungent odors.

Methane emissions is one of the more significant sources of greenhouse gas emissions in California, and the EPA has been targeting methane emissions at landfills. In 2014, the EPA proposed requiring that new municipal solid waste landfills implement measures to capture two-thirds of methane and air toxics emissions by 2023. In 2015, the EPA proposed further reductions of emissions of methane-rich landfill gas, which would also reduce emission of VOCs and air toxics, such as benzene, toluene, and vinyl chloride. However, California's requirements for methane control still exceed federal standards with respect to methane collection and control, component leak testing and surface emissions monitoring, and compliance times. The California Air Resources Board is requesting the EPA to consider using California's statewide landfill methane reduction plan as a model for national laws.

Hazardous Waste Facilities

Landfill facilities are categorized into three classes based on the type of accepted waste.

- **Class I landfill.** These facilities are authorized to accept hazardous and nonhazardous waste. Class I landfills allow hazardous and nonhazardous materials, and are required to be equipped with liners, a leachate collection and removal system, and a groundwater monitoring system to protect the health of people, animals, and the environment.
- **Class II landfill.** These facilities may accept "designated" and nonhazardous waste. Designated wastes include nonhazardous waste that contains pollutants that could be released at concentrations in excess of applicable water quality objectives, or could cause degradation of waters of the state or hazardous waste which has been granted a variance.

- **Class III landfill.** These facilities may only accept nonhazardous wastes, commonly called municipal solid waste, and does not need to be isolated from the surrounding environment. Typically, it includes solid refuse from food processing, wood, trees, inert waste, etc. San Bernardino County's landfills are Class III and prohibited from accepting hazardous waste.

Hazardous wastes are required to be disposed in a prescribed manner to protect the health of the public, animals, and the environment. Hazardous waste produced in San Bernardino County is disposed at the Chemical Waste Management facility in Kettleman Hills (Kings County), Safety-Kleen facility in Buttonwillow (Kern County), or an out-of-state facility. The nearest landfills accepting hazardous waste are U.S. Ecology in Nevada, USPCI in Utah, and Envirosafe in Idaho.

Figure 4-1 shows the location of solid waste facilities in the County.

Other Special Wastes

San Bernardino County residential, commercial, industrial, and medical land uses generate a range of hazardous waste products that require special handling, recycling, and disposal due to the nature of the waste and its negative impacts to public health, animals, and the environment. Among others, these include: 1) household hazardous wastes, 2) used tires, and 3) medical wastes.

Household Hazardous Wastes

Many common products contain potentially hazardous ingredients and require special care when disposed of. These include batteries, drain cleaners, used oil, electronic wastes, antifreeze, household cleaners, paints, pesticides, solvents, and other chemicals. It is illegal to dispose household hazardous waste in the garbage, storm drains, or onto the ground because these wastes can contaminate soil, air, water, and possibly food. San Bernardino County's Household Hazardous Waste Program has 14 permanent household hazardous waste collection facilities, a conditionally exempt small generator program, and 6 antifreeze, oil and latex paint collection facilities. In FY 2014/2015, these facilities collected 3.4 million pounds of household hazardous wastes. Of that total, 56 percent was recycled, 27 percent was disposed through authorized paint-care facilities, 10 percent was disposed through destructive incineration, and the remaining 7 percent was disposed through other means.

Waste Tire Disposal

California is faced with diverting more than 42 million reusable and waste tires generated annually. Tires present significant hazards for fire, illegal dumping, and rodent and disease management. While about 90 percent of waste tires are diverted through reuse, retreading, and burning, waste tires are also disposed through transport or burning. CalRecycle licensed 145 tire haulers in San Bernardino County and 14 businesses that accept tires. However, many facilities accepting tires (e.g., tire retreaders, auto dismantlers, tire dealers, and small volume dealers) do not require licenses from CalRecycle. In recent years, waste tires have become an attractive alternative fuel for certain industries. The State of California licenses two facilities in the High Desert to burn tires. In 2013, Cemex Cement (in Apple Valley) burned 3.1 million tires, and Mitsubishi Cement (in Lucerne Valley) burned 2.0 million tires.

Figure 4-1 Waste Disposal and Landfill Sites

4. Hazardous Materials

This page left intentionally blank

Medical Waste

Medical waste is generated in hospitals, clinics, veterinary or dental offices, and any other facility involved in patient care or laboratory research. Medical waste generators in San Bernardino County, register with the San Bernardino County Public Health Department, who is responsible for safe management of medical waste to protect the public and the environment. As part of the state's cradle-to-grave approach for hazardous wastes, state law requires the tracking of medical waste from its generation to storage, transport, and eventual disposal. San Bernardino County has 10 licensed medical waste transporters, 2 licensed transfer facilities, and 1 licensed medical waste treatment facility. An additional 29 locations countywide accept medical sharps from residences in San Bernardino. Medical wastes are generally disposed of through sterilization, incineration, and/or other means.

4.3 IMPLEMENTING AGENCIES

Although the federal government sets the framework with laws and regulations affecting the generation, storage, transport, and disposal of hazardous waste and materials, the state and local governments have primary responsibility for implementing regulations. Key agencies are below.

4.3.1 Primary Responsible Agencies

California Environmental Protection Agency

Cal/EPA's mission is to restore, protect, and enhance the environment, and to ensure public health, environmental quality, and economic vitality. Cal/EPA coordinates state environmental programs and addresses the greatest environmental and health risks. Cal/EPA is also responsible for the state and federal Superfund programs for the management and cleanup of hazardous materials in accordance with the Carpenter-Presley-Tanner Hazardous Substances Account Act of 1984, known as the California Superfund Act. Cal/EPA oversees six agencies: Air Resources Board, CalRecycle, Department of Pesticide Regulation, DTSC, Office of Environmental Health Hazard Assessment, and State Water Resources Control Board.

Office of the State Fire Marshal

In 1981, the California Legislature established the Hazardous Liquid Pipeline Safety Act with the intent that the OSFM would exercise exclusive safety regulatory and enforcement authority over intrastate pipelines carrying hazardous liquid, in accordance with Section 51010 of the California Government Code. The OSFM is certified annually by the PHMSA to conduct inspection and enforcement of federal safety regulations on intrastate pipelines in California. Inspection of the interstate pipeline system in California is the responsibility of PHMSA. OSFM Pipeline Safety staff inspects pipelines to ensure compliance with safety laws and regulations. OSFM is also responsible for the investigation of all spills, ruptures, fires, or pipeline incidents for cause and determination of probable violations, working with CAL FIRE and local authorities.

California Public Utilities Commission

The CPUC ensures that the state's pipeline systems carrying natural gas and liquid petroleum gas are designed, constructed, operated, and maintained according to safety standards set by the CPUC and the

federal government. The CPUC endorses a "system safety approach" embodied in the federal government's regulations used by the Pipeline and Hazardous Materials Safety Administration. State and federal regulators are tasked with ensuring the following: 1) that pipeline and hazardous materials operators have risk management programs in place; 2) that those programs are designed in conformance with state and federal laws and regulations, 3) that the programs are effective in enhancing public safety, the operator's employees' safety, environmental safety, and 4) that the safety of the entire system and operation continues to improve.

California Department of Toxic Substances Control

DTSC's mission is to protect California's people and environment from harmful toxic substances by restoring contaminated resources, enforcing hazardous waste laws, reducing hazardous waste generation, and encouraging the manufacture of chemically safer products. In California, DTSC is the principal agency responsible for regulating hazardous waste facilities, overseeing the cleanup of hazardous waste sites, and regulating hazardous waste through permitting and enforcement. DTSC is also authorized to develop regulations, policies, guidance, and technical assistance/training to ensure the safe storage, treatment, transportation, and disposal of hazardous wastes. DTSC has delegated enforcement of regulations to the San Bernardino County Fire Department.

State Water Resources Control Board

The SWRCB regulates surface and groundwater quality pursuant to the Porter-Cologne Water Quality Act, the federal CWA, and the Underground Tank Law. Under these laws, regional offices are authorized to supervise the cleanup of hazardous wastes sites referred by local agencies in situations where water quality may be affected. In San Bernardino County, the Lahontan RWQCB in Victorville is the regional office. Depending on the nature of contamination, the lead agency responsible for the regulation of hazardous materials at the site can be the DTSC, RWQCB, or both. In general, contamination that involves soil and groundwater is handled by the RWQCB, and contamination of soil alone is handled by DTSC. SWRCB has the authority to promulgate regulations to safeguard the waters of California.

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment (OEHHA) is the lead state agency for the assessment of health risks posed by environmental contaminants. OEHHA's mission is to protect human health and the environment through scientific evaluation of risks posed by hazardous substances. OEHHA implements the Safe Drinking Water and Toxic Enforcement Act of 1986, commonly known as Proposition 65, and compiles the state's list of substances that cause cancer or reproductive harm. The Office also develops health-protective exposure levels for contaminants in air, water, and soil as guidance for regulatory agencies and the public. These include public health goals for contaminants in drinking water and both cancer potency factors and noncancer reference exposure levels for the Air Toxics Hot Spots Program.

CalRecycle (formerly the Integrated Waste Management Board)

The California Department of Resources Recycling and Recovery, known as CalRecycle, is a department within the California Environmental Protection Agency. CalRecycle administers, promulgates rules and

regulations, and provides oversight for all California's state-managed waste handling and recycling programs. Known mostly for overseeing beverage container and electronic-waste recycling, CalRecycle is also responsible for organics management, used tires, used motor oil, carpet, paint, mattresses, rigid plastic containers, plastic film wrap, newsprint, construction and demolition debris, medical sharps waste, household hazardous waste, and food-scrap composting. CalRecycle oversees a range of regulations and programs geared toward achieving a 75 percent reduction in solid waste disposal in every jurisdiction in California.

Local Agencies

Three County departments have the primary responsibility for regulating the generation, transportation, cleanup, and disposal of hazardous materials and wastes in San Bernardino County.

San Bernardino Public Health Department

San Bernardino County Public Health Department, Department of Environmental Health Services oversees the regulation of medical waste generators in accordance with the Medical Waste Management Act. The program inspects medical waste facilities and facilities with on-site medical waste treatment units, and complaints regarding mishandling of medical waste and facilities that may be operating without a valid health permit. Some facilities that may generate medical waste include hospitals; skilled nursing facilities; blood banks; and doctor, dentist, and veterinarian offices. Facilities that generate 200 pounds or more of medical waste in any month must register with the County. If the facility treats medical waste on-site, a permit and a Medical Waste Management Plan are required. Smaller generators may or may not be subject to the same registration and permitting requirements.

San Bernardino County Public Works Department

The County of San Bernardino, Solid Waste Management Division, is responsible for the operation and management of the County of San Bernardino's solid waste disposal system. The Solid Waste Management Division administers the County's solid waste handling franchise program and the refuse collection program, both of which authorize and regulate trash collection by private haulers in unincorporated areas. The County's Environmental Management Division administers the NPDES program, which is mandated by the federal Clean Water Act and implemented by the State Water Resources Control Board. The stormwater management program has the goal of preventing pollutants from entering lakes, streams, rivers, and oceans through the prevention, treatment, and diversion of runoff from roadways, construction sites, agricultural fields, and businesses.

San Bernardino County Fire Department

SBCFD is responsible for protecting public health and the environment by ensuring that hazardous materials and wastes are properly handled, stored, and disposed. This is accomplished through inspection, site remediation, emergency response, and hazardous waste management. The State of California has designated SBCFD as the county's Certified Unified Program Agency. SBCFD also manages six hazardous material and hazardous waste programs:

- Hazardous Materials Release Response Plans and Inventory (Business Plan)

4. Hazardous Materials

- California Accidental Release Program
- Underground Storage Tanks
- Aboveground Petroleum Storage Act/Spill Prevention, Control, and Countermeasure Plan
- Hazardous Waste Generation and Treatment
- Hazardous Materials Management Plans and Inventory Statements

5. FIRE HAZARDS

This chapter addresses five topics: 1) introduction to fire hazards; 2) governmental regulations that address these hazards; 3) an inventory of wildland and urban fire hazards and events in San Bernardino County; 4) mapping of hazards; and 5) organizations responsible for addressing them.

5.1 INTRODUCTION

San Bernardino County is at great risk from wildfires due to weather, topography, vegetation, seasonal Santa Ana winds, and prolonged drought. From 2000 to 2014, 77 wildfire events caused 142 injuries and fatalities and an estimated $1.5 billion in damages to property, crops, public facilities, and infrastructure (HVRI 2015). For incorporated cities, however, urban fires are a greater threat. While estimates of damages are not available, local fire departments respond to thousands of calls for medical service, accidents, hazardous material incidents, disaster assistance, and other fire-related events.

Fire prevention and suppression is a major public safety responsibility in San Bernardino County.

Fire prevention and suppression is a major public safety responsibility in San Bernardino County.

The complexity of fire hazards in the desert, mountains, and valley underscore the importance of understanding and addressing it into the countywide general plan.

This chapter on fire hazards was prepared to support the updated Safety Element and environmental impact report for the countywide general plan. This chapter provides a discussion of the wildland and urban fire hazards that may lead to the loss of life, bodily injury, property damage, litigation, impacts to lifelines and infrastructure, and disruption to commerce. This chapter also discusses variations in hazards between the Desert, Mountain, and Valley regions where applicable. The objective is to provide information on known and potential hazards that will assist the County in making land use decisions, planning for service priorities, and protecting the health and welfare of the public.

This chapter relies on an extensive array of literature, aerial imagery, and mapping where available. Sources of information reviewed for this assessment include the California Department of Forestry and Fire Protection, US Forest Service National Forest Land and Resource Management Plan, national standards for fire suppression, San Bernardino County ordinances, the 2007 General Plan, US Geological Survey postfire landslide assessments, and the 2007 General Plan Safety Background Report. A full listing of resources consulted for this evaluation and assessment is cited under references in Chapter 7. No fieldwork was performed.

5. Fire Hazards

5.1.1 REGULATORY SETTING

Federal law, state statutes, and local codes regulate planning and mitigation of fire hazards. The following are pertinent to the fire safety component of the Countywide Plan and EIR.

Federal Regulatory and Planning Context

National Fire Protection Association

National Fire Protection Association (NFPA) codes, standards, recommended practices, and guides are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together professionals representing various viewpoints and interests to achieve consensus on fire and other safety issues. NFPA standards are recommended guidelines in fire protection but are not laws or "codes" unless adopted as such or referenced as such by the California Fire Code or the local fire agency. In particular, the NFPA sets forth standards for effective and efficient organization and deployment of fire suppression operations, emergency medical operations, and special operations by career fire departments (NFPA 1710) and volunteer fire departments (NFPA 1720). NFPA also sets standards for minimum water supplies for suburban and rural fire fighting (NFPA 1141 and 1142).

National Fire Plan

In 2000, a National Fire Plan was created to reduce fire impacts on rural communities and ensure that fire districts would be sufficiently staffed to handle future active seasons. The Forest Service, U.S. Fish and Wildlife Service, Bureau of Indian Affairs, Bureau of Land Management, and National Park Service use the National Plan Operations and Reporting System to plan and report accomplishments funded by the National Fire Plan. There are five key areas addressed under the National Fire Plan: Firefighting and Preparedness, Rehabilitation and Restoration, Hazardous Fuels Reduction, Community Assistance, and Accountability. The U.S. Fire Administration, a subdivision of FEMA in the Department of Homeland Security (USFA 2016a), prepares the national plan. The US Fire Administration also synthesizes data and research for the fire community and national plan.

Healthy Forests Restoration Act of 2003

The HFRA is the central legislative component of the Healthy Forests Initiative. The HFRA contains provisions to expedite the preparation and implementation of hazardous fuels reduction projects on federal land and provides assistance to rural communities, states, and landowners in restoring healthy forest and watershed conditions on state, private, and tribal lands. The act authorizes silvicultural research, acquisition of conservation easements, and monitoring and early warning systems for insect and disease outbreaks. HFRA also provides guidance for communities to prepare a Community Wildfire Protection Plan (CWPP) to improve protection from the threat of wildfires through community-level fuel reduction projects. San Bernardino County communities developing CWPPs include: Angelus Oaks, Big Bear Valley, Lytle Creek, Mill Creek Canyon/Forest Falls, Mt. Baldy, Mountain Rim, Oak Glen, Rancho Cucamonga, Wrightwood, and Arrowhead.

California Regulatory and Planning Context

California Strategic Fire Plan

Public Resources Code Section 4114 and 4130 authorize the State Board of Forestry and Fire Protection (Board) to establish a fire plan that, among other things, establishes the levels of statewide fire protection services for State Responsibility Area (SRA) lands. The 2012 Strategic Fire Plan for California is the statewide plan for adaptive management of wildfire. The plan is a cooperative effort between the Board of Forestry and Fire Protection and CAL FIRE. The central goals that are critical to reducing and preventing the impacts of fire revolve around suppression and fire prevention efforts. While the plan puts emphasis on prefire adaptive management of risk, including measures such as fuel breaks, defensible space, and other fuel reduction strategies, the plan does not contain specific regulations but rather acts as an assessment of current fire management practices and standards and makes recommendations on improving the practices and standards in place (CAL FIRE 2012).

San Bernardino County Unit Fire Plan

The California Strategic Plan is implemented through individual "Unit Plans" that are prepared for different regions of the state. CAL FIRE's fire suppression operations are organized into 21 units, which geographically follow county lines. CAL FIRE has adopted a separate San Bernardino Unit Fire Plan, which covers the counties of San Bernardino, Inyo, and Mono. The Unit Plan sets forth the agency's priorities for the prevention, protection, and suppression of wildfires in the three-county area. The Unit Fire Plan is completed annually to address how it is achieving the goals and objectives of the California Strategic Fire Plan. The overall goal of the San Bernardino Unit Fire Plan is to reduce total costs and losses from wildland fire in the unit by protecting assets at risk through focused prefire management prescriptions increasing initial attack success and through engaged collaboration with local stakeholders and public agencies. The last Unit Plan was updated in 2015.

Senate Bill 1241 of 2012

Senate Bill (SB) 1241, enacted in 2012, amended the California Government Code Section 65302 to address wildfire safety in general plans. SB1241 requires that general plan safety element updates address wildfire risk in State Responsibility Areas and Very High Fire Hazard Severity Zones in Local Responsibility Areas. In summary, SB 1241 requires that the safety element do the following:

- Identify wildfire hazards with the latest state-prepared very high fire severity zone maps from the Board of Forestry and Fire Protection, US Geological Survey, and other sources. Most jurisdictions have updated local maps but have not addressed the remaining requirements.
- Demonstrate that the city or contract agency and associated codes satisfactorily address adequate water supply, egress requirements, vegetation management, street signage, land use policies, and other criteria aside to protect from wildfires
- Establish in the safety element (and other elements that must be consistent with it) a set of comprehensive goals, policies, and *feasible* implementation measures for protection of the community from unreasonable risks of wildfire.

5. Fire Hazards

SB 1241 also requires that a draft of the revised safety element be provided to the State Board of Forestry and Fire Protection for review prior to adoption by the local jurisdiction. While the Board's recommendations are advisory in nature, the jurisdiction must also respond in writing to comments. The current general plan will need to address new state laws affecting the planning for wildfire.

Fire Safe Regulations

The Board of Forestry and Fire Protection is authorized in the Public Resources Code (Section 4290 and 4291) to adopt minimum fire safety standards for new construction in very high fire hazard severity zones. The Board published its fire safety regulations in the California Code of Regulations, Title 14. The Board's fire safety codes and regulations were significantly updated in 2014/2015. Fire safety requirements currently promulgated by the Board address, among other things:

- Roadway width and access standards for fire equipment
- Standards for signs identifying streets, roads, and buildings
- Minimum water supply reserves for emergency fire use
- Fuel breaks, greenbelts, and defensible space standards

Since 2015, San Bernardino County has been working with the Board of Forestry and Fire Protection to certify their current fire safety regulations. Rather than simply adopt the state's fire standards, the County has been pursuing an alternative approach provided for in state law where state certification is appropriate if the County can demonstrate that their regulatory framework meets or exceeds the state's minimum fire regulations and therefore has the "same practical effect." In 2016, the Board prepared a formal letter declining to certify the County's fire regulations for very high fire severity zones. The County is continuing to work with the Board to address remaining certification issues.

California Fire Code

The California Fire Code (CFC) is a series of building, property, and lifeline codes outlined in Title 24, Chapter 9 in the California Code of Regulations. The CFC is based on the International Fire Code, which is a collection of best practices agreed upon by professional fire agencies and organizations. The CFC uses a hazards classification system to outline the measures to take to protect life and property. It also regulates hazardous materials at fixed facilities. The fire code, along with the building code, is updated every three years to incorporate recommendations by the International Code Council. San Bernardino County adopted the most recent 2013 update of the CBC, pursuant to Ordinance No. 4255. The 2016 triennial update of the California Building Code (including fire code) is now available.

As part of the adoption of the 2013 California Building Code, the San Bernardino County Fire Department has adopted amendments to the fire code to address local geologic, topography, climate, and land use hazards that present a greater risk for fire in communities across the county. The most recent amendments can be found at: http://cms.sbcounty.gov/portals/58/Documents/Community_Safety/SBCF_Protection_District_Code.070814.pdf

Key Local Codes and Regulations

San Bernardino County General Plan (2007)

The General Plan Safety Element includes land use compatibility charts that detail considerations when siting land uses in or near known or potentially known seismic, geologic, and flooding hazards. The County General Plan does not contain a land use compatibility matrix for fire safety hazards. Rather, broad guidance is provided in various chapters of the general plan. One of the key programs is to create a Countywide Fire Master Plan and provide standards of coverage commensurate with the characteristics of the county that achieve the service standards in NFPA 1710 and 1720. The Circulation Element (Goal CI-16) supports the continued improvement of existing fire facilities, creation of new facilities, and improvement of related infrastructure needed for fire service delivery.

The Safety Element (Goal S-3) states that "the County will protect its residents and visitors from injury and loss of life and protect property from fires." It supports this goal with policies to properly fund and staff the Fire Department while aiding in the identification of cost-effective strategies. General Plan programs to support this goal include the creation of a Fire Protection Master Plan, a requirement that new development create a site-specific fire plan, a requirement that large developments ensure adequate fire protection services (including adequate water for fire protection in accordance with the Peakload Water Supply Systems guidelines), and minimizing the encroachment of new development into the urban/wildlands interface, especially in areas of high fire risk.

San Bernardino County Fire Safety Overlay Ordinance

As of April, 2017, the San Bernardino County Development Code (Section 82.01.020 and 82.01.030) sets forth a Fire Safety Overlay to provide greater public safety in areas prone to wildland fires. The FS Overlay delineates three fire safety areas that correspond to associated wildland fire hazards.

- **Fire Safety Area 1 (FS1):** FS1 includes areas within the mountains and valley foothills, including all the land within the San Bernardino National Forest boundary and is characterized by areas with moderate and steep terrain and moderate to heavy fuel loading.
- **Fire Safety Area 2 (FS2):** FS2 includes areas to the north and east of FS1 in the mountain-desert interface and is characterized by moderate terrain and light to moderate fuel loading. FS2 is subject to high winds that may affect wildfire spread.
- **Fire Safety Area 3 (FS3):** FS3 includes areas to the south of FS1 in the wildland-urban portion of the Valley Region and is characterized by varying terrain. The proximity of FS1 and Santa Ana winds exposes development in FS3 to wildland fire hazards.

Development standards differ for each of the Fire Safety Overlay Districts, although all districts require conformance with the standards and provisions of the California Building Code, Chapter 7A (Materials and Construction Methods for Exterior Wildfire Exposure). Standards address housing density, site development (access, fencing, water supply, setbacks, signage), building separation, building construction requirements, firefighter access, and dead-end road length. The FS Overlay also outlines requirements for erosion control and alternate hazard protection measures.

5. Fire Hazards

The County is considering an update to the Fire Safety Overlay, based on a finding by the Land Use Services and Fire Departments that:

- The Fire Safety Overlay was outdated and not consistent with Title 24 of the California Code of Regulations.
- The three zones have different building requirements, which tend to cause confusion for builders and designers.
- Certain portions of the Fire Safety Overlay map areas are outside the boundaries of the Fire Hazard Severity Zone maps, as approved by the state Department of Forestry and Fire Protection, and as such, are not located in significant fire hazard areas.

Pending approval, the current overlay districts (FS1, FS2 and FS3) will be consolidated into one FS District. In addition to streamlined Development Code regulations, additional changes include:

- Certain portions of these FS Overlay map areas are outside the boundaries of the Fire Hazard Severity Zone maps, as approved by CalFire. These areas are not located in a significant fire hazard area and will be removed.
- The new ordinance amends or eliminates the requirements that conflict with the California Building Code, Chapter 7A and the California Residential Code, Chapter 337. These aforementioned California code requirements include fire and ember resistive exterior decking, fascia material, exterior glazing, insulation and roof vents, which will still apply within the Fire Safety Overlay area.
- These revisions will maintain consistency with the State requirements, provide for more consistent application of these requirements by the County, and serve to further clarify the wildfire risk areas designated by County Fire.

5.1.2 IMPORTANT TERMS

The following important terms for wildfire hazards are used in this section.

Assets at Risk

Assets at risk refer to people, property, and the environment that could be harmed during a wildfire. Assets at risk include life and safety; timber; rangelands for grazing; agricultural uses and crops; recreation; water and watershed; plants; air quality; cultural and historical resources; unique scenic areas; buildings; and wildlife, and ecosystem health.

Automatic Aid

Automatic aid is assistance that is dispatched automatically by a contractual agreement between two fire departments, communities, or fire districts when a fire emergency occurs. It differs from mutual aid, which is arranged on an as-needed and requested basis. An automatic aid agreement is a frequently used tool to provide assistance for cities, counties, and communities in San Bernardino County.

Community Wildfire Protection Plan (CWPP) •

A plan developed in the collaborative framework established by the Wildland Fire Leadership Council and agreed to by state, tribal, and local government, local fire department, other stakeholders, and federal land management agencies managing land in the vicinity of the planning area. A Community Wildfire Protection Plan (CWPP) identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land that will protect one or more at-risk communities and essential infrastructure and recommends measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection.

Fire Safe Councils

California Fire Safe Council (CFSC) is a state-wide nonprofit that provides wildfire education and outreach support and capacity-building assistance to organizations in California that are engaged in fire preparedness.

Defensible Space

An area either natural or man-made where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, defensible space is defined as an area of 30 to 100 feet around a structure that is cleared of flammable brush or vegetation.

Fire Hazard

Dangerous accumulation of flammable fuels in wildland areas, usually referring to vegetation or the flammable materials that may be ignited by the various fire risks or cause fires to increase in intensity or rate of spread. In an urban area, fire hazards are defined in terms of susceptible land uses.

Fire Hazard Severity Zone

A designated area in which the type and condition of vegetation, topography, fire history, and other relevant factors demonstrate an increased possibility of uncontrollable wildland fire. As part of CAL FIRE's responsibilities, it assigns fire severity—moderate, high, and very high—to areas in California for fire planning and suppression purposes. CAL FIRE is currently updating its maps statewide.

Fire Responsibility Areas

California's wildlands have been divided into three zones or responsibility areas, depending on the agency with primary financial responsibility for addressing the prevention, suppression, and postfire recovery of fire. These include local responsibility area (LRA), state responsibility area (SRA), and federal responsibility area (FRA) as defined below.

- **Local responsibility areas** (LRAs) are the areas of California where local jurisdictions (e.g., city fire departments, fire protection districts, counties, and by CAL FIRE under contract to local government) are responsible for the prevention and suppression of wildfires.

5. Fire Hazards

- **State Responsibility Areas** (SRAs) are the areas of California where the State of California is financially responsible for the prevention and suppression of wildfires. SRA does not include lands within city boundaries or in federal ownership.
- **Federal Responsibility Areas** (FRAs) are the areas of California where the federal government has the primary financial responsibility for preventing and suppressing fires. These lands are generally protected by a variety of federal agencies.

Fire Management Plan

A strategic plan that defines a program to manage wildland and prescribed fires and documents the fire management program in an approved land use plan. The plan is supplemented by operational plans for preparedness, preplanned dispatch, prescribed fire, and prevention.

Fuel Breaks

Fuel breaks are wide strips of land on which trees and vegetation has been permanently reduced, thinned, or removed. These areas can slow, and even stop, the spread of a wildland fire because they provide less fuel to carry the flames. They also provide firefighters with safe zones to take a stand against a wildfire or retreat from flames if the need arises.

Hazardous Material

Hazardous material is "any material that because of its quantity, concentration, or physical or chemical characteristics poses a significant present or potential hazard to human health and safety or the environment." Substances that are flammable, corrosive, reactive, oxidizers, radioactive, combustible, or toxic are hazardous. Hazardous materials can be liquids, solids, or contained gases; the by-products of manufacturing; discarded used materials or discarded unused commercial products; or pesticides.

Prefire Management

The comprehensive application of safety, fire prevention, and fire hazard reduction techniques aimed to prevent the ignition of wildland fires, prevent the damage fires can cause, reduce the costs of suppressing the fires, and improve forest health. This includes techniques such as fuel management, fuel breaks, prescribed burns, fire-safe landscaping, and other techniques.

Public Protection Classification (PPC)

PPC is a rating of fire existing protection determined by ISO (Insurance Service Officers), an advisory risk reduction organization that analyzes information on fire-protection services and facilities in communities throughout the country. There are ten classes based on a PPC 105.5-point scale. The top fire protection rating is Class (90 or more points) and the lowest rating is Class 10 (0 to 9.99 points). A Class 10 rating indicates inadequate facilities and other resources to suppress fires.

Urban Fire

Urban fires are defined as fires that occur to buildings, structures, or property—typically in a city, community, or other similar area. In contrast to wildland fires that occur on open, undeveloped areas, urban fires may occur in residential, commercial, and industrial structures; in vehicles or other personal

property; or on infrastructure (e.g., freeways, roadways, etc.). Urban fires, particularly in industrial areas, may pose a significant threat from chemical or hazardous materials.

Wildfire

Any uncontrolled fire spreading through vegetative fuels that threatens to destroy life, property, or resources, as defined in California Public Resources Code Section 4103 and 4104. In contrast to fires occurring within a traditional built environment, a wildfire occurs in wildland areas, including wildland-rural intermix and wildland urban interface.

Wildlands

This term refers to forests, shrub lands, grasslands, and other vegetation communities that have not been significantly modified by agriculture or human development. For fire planning purposes, it refers to an area in which development is essentially nonexistent (except for roads, power lines, railroads, and other transportation infrastructure). Structures, if any, are widely scattered.

Wildland-Rural Intermix

Where rural development and the wildland meet and intermix with no clearly defined separation or interface. The foothill and mountain developments in central and northern California are good examples. This may include small communities or rural sprawl around a community.

Wildland-Urban Interface

The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Due to its location, this area is at a high risk from wildfires spreading to structures, homes, and other personal property. The WUI area is also an area identified by the state as a "fire hazard severity zone," in accordance with the Public Resource Code and Government Code, to be at significant risk from wildfires.

5.1.3 RECENT FIRE HAZARDS

Fire history for a specific region can offer insights into fire type, frequency, vulnerable areas, ignition sources, and other key aspects that help explain the local fire environment. The fire history data compiled by the Fire Resource and Assessment Program, which is maintained by CAL FIRE (CAL FIRE 2015b) in conjunction with the Forest Service, is useful for evaluating areas subject to more frequent burning and, therefore, which areas may be subject to burning in the future. This dataset allows fire history to be disaggregated by county, including San Bernardino County.

Wildfires in the county are concentrated primarily within the Mountain Region, where the forestland provides significant fuel. Fires in the Desert Region are concentrated along its southwest boundary, abutting the Mountain Region and along the long stretches of freeways that run to the Nevada border. The Mountain Region has been subject to repeated burns, with some areas burning 12 or more times in the past century. Table 5-1 summarizes major fires in the county in the last 25 years. Figure 5-1 display locations of wildfires in the county since the early 1900s.

5. Fire Hazards

Table 5-1. Major Wildfires and Urban Fires in San Bernardino County

Fire Location and Date	Magnitude and Cause	Description
Wildfire Response		
Panorama Fire Mountain Region Date: 11/24/1980	23,600 acres Cause: Arson	The Panorama Fire started north of San Bernardino. Driven by 75 mph winds (with gusts topping 100 mph) and high temperatures, the fire quickly spread to mountain and high desert communities. The fire burned an estimated 23,600 acres, destroyed 350 structures, and cost an estimated $46 million in property suppression costs. The fire caused 4 fatalities and 77 serious injuries.
Willow Fire Mountain Region Date: 08/28/1999	63,000 acres Cause: N/A	The Willow Fire started near Lake Arrowhead. Driven by erratic winds, high temperatures, and low humidity, the fire quickly spread. Evacuations in nearby communities and campgrounds were in effect. The fire burned an estimated 63,000 acres, destroyed 60 structures, and cost an estimated $8.5 million in suppression costs. No injuries or fatalities were reported.
Grand Prix Fire Valley/Mountains Date: 10/21/2003	70,000 acres Cause: Human	The Grand Prix Fire started in north Fontana, in the Hunter's Ridge community. It threatened hillside communities north of SR-10, from Alta Loma to San Dimas and northward to Mt. Baldy Village and resulted in significant evacuations. The fire burned an estimated 70,000 acres, destroyed 250 structures, and cost an estimated $11.6 million in suppression costs. No lives were lost.
Old Fire Mountain Region Date: 10/25/2003	91,300 acres Cause: Under Investigation	The Old Fire started in Waterman Canyon. Fueled by strong Santa Ana winds, the wildfire quickly spread, causing the evacuation of up to 80,000 residents from Highland and San Bernardino to Cedar Glen to Lake Arrowhead. The fire burned an estimated 91,300 acres, destroyed 1,000 structures, and cost an estimated $42.6 million in suppression costs. Six lives were lost.
Sawtooth Fire Mountain Region Date: 07/09/2006	61,700 acres Cause: Lightning	The Sawtooth-Millard-Heart Complex Fire was a group of wildfires started by lightning. Several communities in Morongo Valley evacuated. The fire burned an estimated 61,700 acres, destroyed more than 100 structures and hundreds of vehicles, and cost an estimated $17 million in suppression costs. The fire caused 1 fatality and 17 minor injuries.
Grass Slide Fire Date 10/22/2007	12,700 acres Cause: under investigation	The Grass Slide Fire began in the Running Springs and Green Valley communities. Mandatory evacuations applied to the surrounding forest communities. The fire burned 12,700 acres, destroyed more than 300 residential structures, caused damages totaling $23.3 million, and injured 9 firefighters. USGS published a landslide susceptibility report following the wildfire.
Freeway Fire Valley Region Date: 11/28/2008	30,000 acres Cause: Vehicle	The Freeway Fire started along SR-91 due to a faulty catalytic converter. Fanned by Santa Ana winds, the fire spread to Yorba Linda, Anaheim Hills, Brea, and Chino Hills—causing evacuation of 40,000 people. The fire burned over 30,000 acres (including all of Chino Hills State Park), destroyed and damaged more than 300 structures, and cost $16.1 million. Fourteen firefighters were injured.
Sheep Fire Date 10/03/2009	7,100 Acres Cause: Human	The Sheep Fire started near Lytle Creek east of Mount Baldy and west of the Cajon Pass in the San Gabriel Mountains. Evacuations were mandatory in Wrightwood, Lytle Creek, and Lone Pine. The fire burned approximately 7,100 acres and destroyed five structures. Eight firefighters were injured but no fatalities were reported. Fire suppression costs totaled an estimated $8 million.
Lake Fire Mountain Region Date: 06/17/2015	31,300 acres Cause: Human	The Lake Fire started along Highway 38, south of Big Bear Lake. It burned the Barton Flats, South Fork, Fish Creek, Coon Creek, Ten Thousand Foot Ridge, Onyx Peak, and Upper Pipes Canyon areas. The fire burned more than 31,000 acres, but caused limited damage to structures, and 6 minor firefighter injuries. No fatalities were reported. Suppression costs totaled $34 million.
Blue Cut Fire Mountain Region Date: 08/16/2016	36,274 acres Cause: Under investigation	The Bluecut Fire started in the Cajon Pass near the I-15. Although initially a vegetation fire, high winds caused the fire to consume 18,000 acres in the first day and eventually spread to consume 36,000 acres. The wildfire forced the evacuation of more than 34,500 homes and 82,000 residents, destroyed 110

Table 5-1. Major Wildfires and Urban Fires in San Bernardino County

Fire Location and Date	Magnitude and Cause	Description
		homes and 200 out buildings, and destroyed more than 200 vehicles. Fire suppression costs totaled approximately $12.3 million.
Urban Fire Response		
Victorville Accident Date: 03/21/1992	Cause: Inclement Weather	In 1992, foggy weather was responsible for three chain-reaction crashes involving nearly 100 vehicles along a portion of I-15 in the Cajon Pass, about a mile south of its summit. About two dozen big-rig trucks and a school bus carrying 53 sixth-graders were involved in the accidents. The chain-reaction accidents killed one person and injured 46 others.
Cajon Dump Fire Date: 1999	Cause: Human	In 1999, an illegal dumpsite formerly owned by the County in the Cajon Pass caught fire. The dumpsite contained 2,000,000 cubic yards of waste consisting of rubble, telephone poles, railroad ties, and trees and shrubs. About 80,000 cubic yards were organic wastes, which spontaneously ignited, causing an underground fire. Fire cleanup costs exceeded $2 million.
San Bernardino Freeway Accidents, Date: 04/30/1999	Cause: Inclement Weather	About 57 separate crashes—involving 200 vehicles--littered 13 miles of the westbound I-10 through the Inland Empire. The accidents were triggered by glare that resulted when a heavy downpour was followed by a break in the clouds, leaving westbound motorists facing the setting sun. 31 ambulances ferried 48 people to hospitals; 30 others were treated at the scene.
Fontana Tire Fire Date: 05/19/2012	Cause: Unknown	In 2012, a fire started at a 10-acre pallet and tire storage yard in Fontana, where pallets were stored two- and three-stories high. Several fuel and propane trucks exploded during the incident, sending embers to an adjacent yard of used truck tires. The tire fire was extinguished with Class B foam. The fire caused $2.5 million in damages and resulted in minor injuries.
Cajon Pass Fire Date: 07/17/2015	Cause: Brush Fire	About 20 cars and trucks in a long line were abandoned on the freeway and caught fire as flames from the 500-acre North Fire, jumped the I-15. Up to 70 cars, trucks and tractor-trailers on I-15 northbound near San Bernardino were subsequently involved in the incident and were damaged or destroyed.

Source: Incident Information Database, CALFIRE, 2016

5. Fire Hazards

Figure 5-1 Fire History in San Bernardino County

This page left intentionally blank

5.2 WILDLAND FIRE HAZARDS

San Bernardino County's fire hazard environment depends on a range of characteristics, with variations unique to different regions. The primary factors include topography, vegetation/fuel mix, weather, and disease, as discussed below.

5.2.1 GEOGRAPHIC SETTING

Valley Region

The Valley Region contains the entire San Bernardino County Valley and the foothills that extend into the San Gabriel Mountains and lower elevations of the San Bernardino Mountains. Elevation ranges from 700 feet above mean sea level (amsl) near Rancho Cucamonga to 4,000 feet amsl near Yucaipa. Topography ranges from the flat valley floor to steep and rugged terrain in foothills and mountains. The Valley Region has a Mediterranean climate, with hot and dry summers and mild winters. Vegetation is predominantly urban fuel with highly combustible grasslands near the foothills. Warm summer temperatures dry vegetation and reduce overall fuel moisture content and increase risk of ignition and fire hazard, particularly in late summer and fall with seasonal Santa Ana winds. Although the Valley Region does not have an extensive history of fires, it is certainly subject to urban fires.

Mountain Region

The Mountain Region consists of the San Bernardino Mountains and San Gabriel Mountains. The Mountain Region has steep terrain, with multiple peaks exceeding 10,000 feet amsl and topping out at San Gorgonio Mountain with an elevation of 11,489 feet amsl. Elevation change is dramatic south and west of the crest of the San Bernardino Mountains, while a gradual descent to the desert found on the north side of these mountains. While annual rainfall can reach 40 inches in some places and snow occurs regularly above 5,000 feet amsl, summer months are relatively dry with occasional thunderstorms. Deeply cut canyons and slopes and combustible vegetation common throughout the mountains, coupled with seasonal Santa Ana winds that can top 80 mph, create a natural fire hazard. Wildfires are generally expected in the Mountain Region on an annual basis.

Desert Region

The Desert Region is composed of the Mojave and Sonoran Deserts, which are defined as both rain shadow desert and mostly high desert. The Desert Region consists of typical valley basin and mountain range topography with steep, mountainous terrain interspersed with wide and relatively flat desert valleys. The majority of the Desert Region ranges from 1,500 to 5,000 feet amsl, with some areas falling below 1,000 feet amsl within valleys and washes. Granite Peak measures at 6,130 feet amsl, while Clark Mountain in the Mojave National Preserve measures 7,929 feet amsl. Historically, relatively few wildfires occur in the Desert region, except the wildland interface fronting the San Bernardino mountains and within certain forested lands managed by federal agencies. While the desert fuel is generally less combustible, Santa Ana winds can and do accelerate the movement of fires.

Slope and Aspect

Steep and mountainous terrain presents the greatest wildfire risk. An upslope draft is often created by surface and downslope air temperature differentials that cause winds to blow upslope during the day. The steeper the slope, the greater the draft created, and the more rapidly a fire will burn upslope. A fire will also spread uphill more quickly as the flames preheat and dry the upslope fuel in its path. Heated air from a fire rises along the slope, increases the draft, and essentially creates its own wind. The aspect, or direction, that a slope faces determines how much heat it receives from the sun or solar radiation. Vegetation on more sun-exposed aspects tends to be drier, ignite more easily, and burn more rapidly. San Bernardino has a prevalence of south- to southwest-facing slopes in the Mountain and Valley regions, which are more exposed to the sun than north- or east-facing slopes.

The shape of the terrain can also affect winds, and therefore the behavior (spreading) of fires. Ridges and mountains are generally horizontal barriers to the movement of fires. In contrast, ravines and gullies can increase funnel winds and change fire direction. Moreover, winds are typically higher through mountain saddles and gaps or passes, leading to drier fuels and more intense fire behavior. Box canyons, or steep canyons that terminate near a steep ridgeline, can produce intense heat and ignitable gases as intense updrafts are created and heat is trapped. These conditions can significantly intensify fire behavior. These terrain features and highly flammable fuels are found within the steep terrain around the mountains in San Bernardino County and must be considered in fire planning.

Vegetation

All vegetation forms are fuel for fire, but some are more flammable than others. Some vegetation types are more flammable based on plant physiology (resin content), biological function (flowering, retention of dead plant material), and physical structure (leaf size, branching patterns). The risk of fire is also related to other factors, including fuel loading (type and density of the fuels), the moisture content of the fuels, and weather (temperature, humidity, rain and wind). Determining fire danger or risk of wildfire at a given time or location takes into account each of these factors. The estimate of fire danger considers potential for energy release (estimate of potential energy released in the active portion of the fire) and fire behavior (potential for surface fire, crown fire, or plume-dominated fire).

Current vegetative fuels are characterized by different vegetation and land cover types, which include 14 different fuel models. In the Desert Region, the predominant vegetative cover is desert fuel, which is generally more resistant to wildfire than other vegetation. Of particular interest in fire protection planning are fuels that produce high heat intensity and high flame lengths, such as chaparral, brush, and forest fuel types, that occur in the wildland-urban interface, the Mountain Region, or adjacent to high-value assets. The Valley Region is comprised predominantly of Urban Fuel, except Chino Hill, communities north of the SR-210, and the Yucaipa Valley Region. Fire behavior in brush fuel types produces higher flame lengths than in grassland, although spread rates are typically slower.

Figure 5-2 maps the vegetative fuel types for fires in San Bernardino County.

5. Fire Hazards

Figure 5-2 Fire – Vegetative Fuel Model Types

This page left intentionally blank

5. Fire Hazards

Weather

In the Desert Region, the climate is generally characterized by hot, dry summers and mild to cold winters. Rainfall events originate from winter frontal storms off the Pacific Ocean and occasional summer convective monsoons, but these sources are variable in different regions of the desert. The Mojave Desert is bounded by the Sierra Nevada, San Bernardino, Tehachapi, and San Gabriel mountain ranges; the Sonoran Desert is bounded by the Peninsular Ranges and Colorado River. These large mountain ranges create a rain-shadow effect that is responsible for the development of the arid desert regions. Multiple ecoregions in the Desert Region have differing climates.

Annual rainfall amounts for the San Bernardino Mountains can reach up to 40 inches in some areas, with the wettest months being November through March. Summers are relatively dry with few thunderstorms. In winter months, snow typically occurs above 3,000 feet in elevation and is common above 5,000 feet. Average annual snowfall amounts in Big Bear Lake is 72 inches. In the summer months, average high temperatures in Big Bear Lake are 81°F with a low of 48°F. During the winter, average temperatures range between 47°F and 21°F (NOAA 2015). Annual rainfall in Big Bear Lake is 20 inches, with most of the precipitation occurring November through March.

The Valley Region has a Mediterranean climate, with hot and dry summers and cool winters. Summers are very hot, with many days over 100°F. Rainfall averages around 12 to 16 inches annually, with most occurring November through April and occasional thunderstorms during the summer months. Warm summers dry vegetation and reduce overall fuel moisture content and increase risk of ignition and fire hazard, particularly in late summer and fall. Santa Ana winds are common in the Valley Region during spring and fall as warm and dry winds blow from the deserts into southern California. Due to the low humidity, seasonal timing, and high velocity, these winds increase wildfire risk in affected areas.

Disease and Pests

Forest pathogens and insect infestations can cause rapid mortality of trees, resulting in increased dead fuel loads. Standing dead trees increase fuel loads and reduce the overall fuel moisture in affected areas, contributing to a substantial increase in wildfire hazard. Dead fuel load requires treatment and/or removal, especially within WUI areas where fires could threaten structures or important assets and represent a serious threat to public safety. Further, care must be taken to avoid transportation of infected tools, chips, and trimmings/plant material into noninfected regions.

Bark beetle infestations and related pine tree mortality is widespread in the mountains; historical outbreaks have destroyed an estimated one-third of all pine trees (CAL FIRE 2015a). Tree mortality due to bark beetles tends to increase during drought when trees are weakened. Polyphagous shot hole borer (PSHB), which has been detected in western San Bernardino County, burrows into a tree and infects it with fungus, leading to mortality. The goldspotted oak borer (GSOB), another introduced beetle, attacks mature oak trees, including coast live oak, canyon live oak, and California black oak. GSOB has not been detected in the county, but has caused significant losses in southern California.

5.2.2 ASSETS AT RISK

Assets at risk refer to people, property, and the environment that could be harmed during a wildfire. Assets at risk include life and safety; timber; rangelands for grazing; agricultural uses and crops; recreation; water and watershed; plants; air quality; cultural and historical resources; scenic areas; buildings; wildlife; and ecosystem health. Assets are summarized in Table 5-2.

Table 5-2. Summary of Assets at Risk

Asset	Relevant	Description
Air Quality	Valley Mountains Desert	The county has some of the most heavily impacted air quality in the state, exceeding state standards for ozone, particulate matter, and other pollutants. Air quality is inherently reduced when wildfires are active due to particulate matter released as smoke.
Biological Resources	Valley Mountains Desert	The county has a high number of endangered and vulnerable endemic flora and fauna that may be negatively impacted by wildfire. Although animals typically move away from fire, the overall ecosystem is fragile, fragmented, and vulnerable.
Post Fire Flooding	Valley Mountains Desert	The combination of soils, topography, climate, and vegetation in the county can result in severe fire and flood cycles, which can result in geologic mass wasting. Significant postfire flooding has occurred in the mountains and valley communities.
Cultural Resources	Valley Mountains Desert	The county has numerous valuable historical and prehistoric sites, many of which are yet to be discovered and do not have site records. While urban fire is less likely to destroy these resources, they may be negatively impacted by wildfire.
Housing	Valley Mountains Desert	Structures in wildland urban interface areas are exposed to a higher risk from wildfires. This is especially true in areas of low-density, high-cost, larger homes with restricted access. In the Valley Region, the high density of fire makes housing subject to damage and destruction.
Utilities	Valley Mountains Desert	A number of 0.1-megawatt or larger hydroelectric facilities exist within the county, which may be negatively impacted by wildfire. Urban and wildfire can destroy other facilities, including transmission lines, pipelines, water systems, and other critical infrastructure.
Transportation Infrastructure	Valley Mountains Desert	The county includes several major electrical transmission lines, CAL NEV pipeline, the BNSF transcontinental railroad route, the California Aqueduct, and major highways, including I-15, US-395, Highways 18, 62, and 138, which may be negatively impacted by wildfire.
Rangeland and Timber	Mountains	Minimal rangeland and timber of limited value. However, the ongoing presence of pest such as the Bark Beetle, Polyphagous Shot Hole Borer, and gold-spotted oak borer continue to weaken pine trees and oak trees–making them susceptible to decay and fire.
Recreation	Valley Mountains Desert	The San Bernardino Mountains, Chino State Park, regional parks, and desert areas are popular recreational areas for hiking, biking, hunting, fishing, camping, skiing, and hang-gliding. These resources may be negatively impacted by wildfire.
Aesthetics	Valley Mountains Desert	Scenic views to and from the San Bernardino Mountains, Big Bear Valley, Highway 395, Highway 18, Oak Glen Road, Angeles Crest Highway, State Route 71, and many other scenic routes that may be negatively impacted by wildfire.
Geologic	Mountains	The San Bernardino Mountains are subject to mountain-top sloughing due to frequent fires and conversion to grasslands followed by heavy rains. Large-scale geologic instability of soils and catastrophic landslides (e.g., 2003 Old Fire) have also occurred.
Water Quality and Aquatic Resources	Valley Mountains Desert	Major watersheds and waterways in the county include the Morongo Basin, Mojave, Santa Ana River, and the California Aqueduct, which may be negatively impacted by wildfire due to increased deposits of ash and debris in waterways.
Hazardous Waste Sites	Desert Valley	The Valley Region has the vast majority of hazardous waste sites associated with commercial and industrial uses, although these uses are also located in the Desert Region. However, landfills and military sites are predominantly located in the Desert Region.

5. Fire Hazards

Environmental Effects of Fires

Though wildfire regimes are important for the health of natural system because it promotes new growth and returns stagnant nutrients to the system, wildfires that occur more frequently than the natural regimes may be detrimental to the health of the ecosystem, encourage the permanence of nonnative species, and negatively affect water resources due to erosion and air quality due to particulate matter. High-frequency fires or low-frequency, high-intensity fires may also lead to large-scale geologic instability of soils and catastrophic landslides. These impacts are summarized below.

Biological Resources

Fire can cause significant changes to vegetation communities and its inhabiting fauna. In a forest vegetation community, the first type of vegetation community to reestablish following fire is grassland, which typically transitions into a shrub community and later into a forest community. However, high intensity or high frequency fires may destroy the seed bank in the soil and result in a permanent conversion of land to nonnative grassland communities. Changing vegetation communities can negatively impact sensitive special-status plant species (USFS 2000a). Moreover, increased availability of nutrients after a fire typically causes an explosion of new vegetation growth, encouraging herbivore populations and, on a smaller level, carnivore populations. Fires also clear out shrubs and trees and therefore favor species that prefer open areas and hinder those that prefer cover (USFS 2000b).

Air Quality

Wildfire smoke typically includes particulate matter, carbon dioxide, water vapor, carbon monoxide, hydrocarbons, and even hazardous chemicals. No two fires will have identical results on air quality; topography, weather, intensity of the fire, and especially wind are important factors that determine the impacts of smoke. While winds typically reduce impacts because of larger areal dispersal, high intensity winds (e.g., Santa Ana winds) can quickly spread wildfires and thus increase negative impacts. It is not uncommon for smoke to linger for several weeks across an entire region. These exceptional events are often recorded as such by regional air quality monitoring programs.

Water Quality

Fire can impact water quality in many ways. A fire leaves behind a layer of loose soot while removing the stabilizing vegetation that helps to retain sediment, making an area more susceptible to erosion. Nearby waterways are subject to increased sedimentation and ash deposits due to erosion and fires. Fires and fire suppression methods can introduce pollutants and chemical compounds that can negatively impact aquatic environments and kill fish and plants. Rising water temperatures from the reduction in shade (due to burning of vegetation cover) can cause water temperatures to rise, negatively affecting the survivability and sustainability of aquatic populations and communities.

These issues are just a few of the many environmental effects of wildland fires that are known to occur statewide, including in San Bernardino County.

5.2.3 COMMUNITIES AT RISK

Wildfires pose the greatest threat to communities nearest to the wildland-urban interface. This refers to the zone of transition between unoccupied land and human development. Not all zone of transitions are neatly delineated. Although technically the terms wildland-urban interface and wildland-rural intermix are two different concepts, the term wildland-urban interface often refers to all types, and wildland-rural intermix to the special case described below.

Wildland-Urban Interface

The wildland-urban interface (WUI) is the zone where wildland vegetation and fuels interface with developed areas is of critical importance for fire planning. San Bernardino County has many such areas, particularly in the area where development in the Valley Region meets wildlands of the Mountain Region. WUI areas are those within the "vicinity" of wildland vegetation, typically with housing density exceeding 1 house per 40 acres, but with vegetation covering less than 50 percent of the parcel. WUI areas are generally within 1.5 miles of an area of wildland vegetation, the anticipated distance that firebrands can be carried to the roof of a house. WUI fire risks include the spread of fire via house-to-house, landscaping-to-house, or ember intrusion.

Fire fighting in WUI areas presents advantages and disadvantages. Within the wildland-urban interface, communities typically have community water supply systems and thus do not rely primarily on private well water. Moreover, many homes at risk of fire can be readily accessed by a single road. Due to closer proximity, emergency equipment can protect multiple assets at once. Additionally, houses usually are only exposed to flammable fuels on one side. On the other hand, fire hazards in wildland-urban areas can be challenging due to the higher housing densities. Congested roads can impede travel and response to emergencies. Moreover, limited options are available if community water systems fail.

Wildland-Rural Intermix

The term wildland-rural intermix refers to a specific type of wildland-urban interface in which the structures are intermixed with wildland fuels, as opposed to a distinct area of wildland fuel adjacent to a developed area. In the intermixed area, wildland vegetation is continuous, and more than 50 percent of the land area is vegetated with combustible fuels. The wildland fire risk associated with intermix areas includes vegetation-to-house fire spread or ember intrusion from a nearby fire. Intermix areas occur throughout the more sparsely developed and rural areas of San Bernardino County, such as unincorporated areas of the desert and portions of the Mountain Region.

Wildland-rural intermix advantages for firefighting include low densities of buildings, while disadvantages include increased risk to firefighters. Emergency equipment can only protect single assets. Emergency equipment response times can be delayed due to rural roads (single lane, windy, heavy fuel loading) and long driveways. Roads can also become congested during emergencies. Finally, houses are often surrounded by vegetation.

5. Fire Hazards

Communities at Risk of Fire

Communities at risk from potential wildfire were identified at the federal level in the 2001 National Fire Plan, which included only communities near federal lands. CAL FIRE has developed a more inclusive list of communities at risk based on: (1) high fuel hazard, (2) probability of a fire, and (3) proximity of intermingled wildland fuels and urban environments that are in close proximity to fire hazard threats. In addition, the County's Multi-jurisdictional Hazard Mitigation Plan also identifies that approximately 30 percent of the population in unincorporated county areas is vulnerable to wildfire.

Table 5-3 lists 72 communities that qualify as "at risk." However, rapidly increasing suburbanization of the Desert Region and development of subdivisions will likely increase the number of scattered communities at risk of wildfire.

Table 5-3. Communities at Risk in San Bernardino County

Adelanto	Devore Heights	Mentone	Rialto
Angelus Oaks	Erwin Lake	Montclair	Rim Forest
Apple Valley	Fawnskin	Moonridge	Running Springs
Arrowbear	Fontana	Morongo Valley	San Antonio Heights
Baldwin Lake	Forest Falls	Mountain Home Village	San Bernardino
Barton Flats	Fredalba	Mountain View Acres	Seven Oaks
Big Bear City	George Air Force Base	Mt Baldy Village	Sugarloaf
Big Bear	Grand Terrace	Muscoy	Summit Valley
Big River	Green Valley Lake	Needles	Twentynine Palms
Bloomington	Hesperia	Oak Glen	Twentynine Palms MCAS
Blue Jay	Highland	Oak Hills	Twin Peaks
Bluewater	Joshua Tree	Old Waterman Canyon	Upland
Cedarpines Park	Lake Arrowhead	Ontario	Valley of Enchantment
Chino	Lake Williams	Phelan	Victorville
Chino Hills	Loma Linda	Pinon Hills	West Cajon Valley
Colton	Los Serrano	Pioneer Town	Wrightwood
Crestline	Lucerne Valley	Rancho Cucamonga	Yucaipa
Devore	Lytle Creek	Redlands	Yucca Valley

Source: Communities at Risk List, CALFIRE, 2016.

The County continues to work to reduce the threat of wild fires through its Fire Hazard Abatement Program, which requires adherence to the fire hazard requirements outlined in San Bernardino County Code Section 23.0301 to 23.0319. The primary function of the Fire Hazard Abatement Program is to reduce the risk of fires by proactively establishing defensible space, reducing or removing flammable materials on properties, and conducting inspections for compliance. Still, the threat of wildland fire remains significant throughout most regions in the county.

Fire Hazard Severity Zone

CAL FIRE is mandated by Public Resources Code 4201-4204 and Govt. Code 51175-89 to identify fire hazard severity zones (FHSZ) for all communities in California. These are areas of significant fire hazard based on fuels, terrain, weather, and other relevant factors. In state responsibility area, CAL FIRE has mapped three hazard ranges – moderate, high, and very high. In local responsibility area, the law only requires identification of very high FHSZ. Local governments to accept CAL FIRE's determination or make other local determinations as described below.

Government Code 51179 states that a local agency may, at its discretion, exclude from the requirements of Section 51182 an area identified as a VHFSZ by the local agency, following a finding supported by substantial evidence in the record that requirements of Section 51182 are not necessary for effective fire protection within the area or 2) include areas within the jurisdiction of the local agency, not identified as a VHFSZ, as a VHFSZ following a finding supported by substantial evidence in the record that requirements of Section 51182 are needed for effective fire protection in the area.

Federal Responsibility Areas

Federal responsibility areas are lands upon which the primary financial responsibility for preventing and suppressing fires is the federal government. These lands are generally protected by the Department of Agriculture, Forest Service; Department of Interior, Bureau of Land Management; National Park Service; US Fish and Wildlife Service; and the Bureau of Indian Affairs. Lands include National Forest lands (e.g., San Bernardino, Angeles, and Joshua Tree National Forest), the Mojave National Preserve and Death Valley National Park, the Havasu Wildlife Preserve, and other lands.

State Responsibility Areas

State responsibility areas are lands classified by the Board of Forestry and Fire Protection on which the primary financial responsibility for preventing and suppressing fires is the state of California. The California Board of Forestry and Fire Protection maintains a website showing the extent of SRA lands, with a searchable address tool that can be accessed online. SRAs are generally immediately to the north and south of the San Bernardino and San Gabriel mountains and the WUI areas. SRAs are updated annually as new applications from jurisdictions and developments are received.

Local Responsibility Areas

Local responsibility areas are lands where the jurisdictional and financial responsibility for fire protection rests with local government agencies. Local responsibility areas are incorporated cities. Fire protection in these areas is typically provided by city fire departments, fire protection districts, counties, and by CAL FIRE under contract to local government. These areas include the vast majority of communities in the Valley Region and the High Desert. The San Bernardino County Fire Department is one of the largest providers of fire protection services in these areas.

Figure 5-3 maps the location of fire hazard severity zones (moderate, high and very high) and Figure 5-4 maps the fire protection responsibility areas (local, state, and federal) in San Bernardino County.

5. Fire Hazards

Figure 5-3 Fire Hazard Severity Zones and Fire Safety Overlay

This page left intentionally blank

5. Fire Hazards

Figure 5-4 Fire Responsibility Areas – Local, State, and Federal

This page left intentionally blank

5.3 URBAN FIRE HAZARDS

Urban fires affect buildings, structures, or property, typically in a city, community, or other similar area. In contrast to wildland fires that occur on open undeveloped areas, urban fires may occur in residential, commercial, and industrial structures; in vehicles or other personal property; or on infrastructure (e.g., freeways, roadways, etc.). Urban fires, particularly in industrial areas, may pose a significant threat because of chemical or hazardous materials.

5.3.1 GEOGRAPHIC SETTING

Valley Region

The Valley Region is the most heavily urbanized area in the county, containing more than 90 percent of the county's population and structures. While some communities near the mountains (e.g., Upland, Rancho Cucamonga, Yucaipa, San Bernardino and Highland) are subject to wildland fires, the primary threat is urban fires. The region also contains the vast majority of infrastructure, hazardous material sites, and commercial and industrial businesses—all of which present a different urban fire hazard. These urban fire threats, coupled with the Santa Ana winds and hot dry summers, can fuel otherwise routine fires. Moreover, as this area also is highly populated, the respective fire departments respond to an extensive number of medical calls and emergencies and traffic-related accidents.

Mountain Region

The Mountain Region is composed of small, tightly knit, and often isolated communities that are spread far apart and geographically difficult to access. These include communities in the Wrightwood area, Big Bear Valley, Forest Falls, and Running Springs/Crestline area, among others. These areas do not contain the density of development, commercial and industrial uses, and hazardous material sites found elsewhere in San Bernardino County. However, the population in mountain communities still requires the fire and emergency services normally associated with more urban fire departments, particularly for medical calls and emergencies. Fires that occur within those communities can also quickly spread to other structures due to the intermix of structures and natural terrain.

Desert Region

The Desert Region consists of typical valley basin and mountain range topography with steep, mountainous terrain interspersed with wide and relatively flat desert valleys. Except for the High Desert region, which is highly populated, most of the Desert Region has very low densities of development. Residential structures generally do not exceed two stories. Commercial and industrial uses are fewer. The land use and building patterns would suggest a less volatile fire environment. However, the Desert Region has a high percentage of seniors and other vulnerable populations that would require medical assistance in certain circumstances. Moreover, the sheer distances required to travel to suppress a structural fire or provide medical assistance would be a significant concern.

5.3.2 INSURANCE SERVICES OFFICE RATINGS

Insurance Services Office (ISO) is a risk management organization that analyzes fire protection services and facility data for communities through its Public Protection Classification (PPC) program. The PCC process includes a 105.5-point evaluation of emergency communications systems, first-alarm responses (engine companies, ladder companies, deployment, equipment, pumping capacity, reserve apparatus, personnel, and training), water supply available for fire suppression purposes, fire prevention code adoption and enforcement, public safety education, and fire investigation.

Only fire department/stations that meet minimum qualifications can receive a PCC rating. First, fire services must be led by one person and organized permanently under applicable local or state laws. The agency must serve an area with definite boundaries (if serving multiple areas, fire suppression services must be provided through a contractual agreement). Active members must receive at least three hours a month of training. Dispatch communications operate must without delay. Finally, the facility must have at least one piece of apparatus, stored indoors, that meets the general criteria of National Fire Protection Association 1901, Standard for Automotive Fire Apparatus.

The FSRS considers several components of a community's fire suppression system, incorporating National Fire Protection Association standards, to determine fire safety ratings. These areas are:

- **Emergency communications.** This refers to how well a fire department receives and dispatches fire alarms, emergency reporting systems, and communications.
- **Fire department.** This includes the type and availability of fire engines and equipment available, training, and response times to respond to a fire emergency.
- **Water supply.** This includes the availability and spacing of fire hydrants, fire flow capabilities, and the number of structures within 1,000 feet from representative locations.
- **Community risk reduction.** Additional points are provided for communities that reduce losses through fire prevention, public fire safety education, and fire investigation

The ratings are split into 10 classes; a Class 1 rating indicates superior fire protection while a Class 10 rating refers to insufficient fire suppression resources. A score with the letter "Y" has superior protection services, but lacks sufficient water supply to receive a higher rating. A score with the letter "X" meets extensive communication, records, and equipment minimums, has at least one apparatus with a permanently mounted pump and water tank, but does not have a credible water supply beyond the tank. If a split class is displayed, the first class applies to properties within 5 road miles of the fire station and within 1,000 feet of a credible water supply; the second class applies to properties within 5 road miles of a fire station, but beyond 1,000 feet of a credible water supply.

Table 5-4 lists the known public protection classification ratings for communities in San Bernardino County. It should be noted that considerable consolidations have taken place in recent years. These consolidations, the closure and reopening of stations, and infrastructure constraints within various communities will likely affect the current PPC rating.

5. Fire Hazards

Table 5-4. San Bernardino County Public Protection Classification Ratings

Division Name	Communities Served	PPC Rating
Fire Division 1 Valley Region	Provides fire protection and paramedic services to the unincorporated areas of Colton, Devore (#2), San Antonio Heights (#12), Lytle Creek (#120, Mt Baldy (#200), Muscoy (#75), Bloomington (#76), Grand Terrace (#23), Mentone, Oak Glen, Little Mountain, Highland, Fontana (#71, #72, #73, #74, #77, #78, #79), and San Bernardino. Special tax paramedic service zones fund services to Highland, Yucaipa, and San Bernardino City. Upland is currently considering annexation to SBCFD.	As of 2016, the PPC ratings for Fire Division 1 are 04/4X, except for Fontana (02/2X).
Fire Division 2: South Desert	Fire Division 2 provides fire protection and paramedic services to the unincorporated areas surrounding Summit Valley (Station #48), Lucerne Valley (#8), Lucerne Valley – East (#7), Phelan (#10), Wrightwood (#14), Pinon Hills (#13), El Mirage (#11), Baldy Mesa (#16), Fire protection services are also provided to Hesperia Fire Protection District (Stations, #302, #304 and #305) through service contracts. Ambulance transport is provided in Lucerne Valley and Wrightwood.	As of 2016, the PPC ratings for Fire District 2 are 03/3X. Volunteer or paid call firefighter stations may not meet minimum qualifications for a PPC rating.
Fire Division 3: North Desert	Fire Division 3 provides fire protection and paramedic services to areas surrounding Spring Valley Lake (#Station 22), Silver Lakes (#4, Mt. View Acres (#37), Harvard (#52), Baker (#53), Hinkley (#56) Searles Valley (#57), and Trona (#57). Fire protection services are provided to Adelanto (#322), Victorville (#311, #312, #313, #314 and #319) Ambulance transport service is provided in Searles Valley. Special tax fire protection zones fund services to Red Mountain, Windy Acres, El Mirage, Helendale/Silver Lakes.	As of 2016, the PPC ratings for Fire Division 3 are 04/4X, Volunteer or paid call firefighter stations were rated 04/10.
Fire Division 4: Mountains	Fire Division 4 provides fire protection services to the areas surrounding Angelus Oaks (Station #98), Fawnskin (#96), Forest Falls (#99), Green Valley Lake (#95), and Lake Arrowhead (#91, #92, #93 and #94). Ambulance transport services are provided to Lake Arrowhead. Fire Division 4 also provides fire protection services to the former mountain communities served in the Crest Forest Fire Protection District (#24, #25, #26, #28, #29, and #30). Additionally, two voter-approved special tax paramedic service zones fund services to the mountain communities.	As of 2016, the PPC ratings for Fire Division 4 are 04/4X, Volunteer or paid call firefighter stations may have different ratings. Big Bear Valley has a PCC -3/3X
Fire Division 5: South Desert	Fire Division 5 provides fire protection and paramedic services to the areas of Big River (#Station 17), Black Meadow Landing (#55), Havasu Landing (#18), Johnson Valley (#43), Joshua Tree (Station #36), Landers (#19), Panorama Heights (#35), Parker Strip (#21), Pioneertown (#38), Yucca Mesa (#42), Yucca Valley (#41), Wonder Valley (#45), and Needles (#31), Twentynine Palms (#421). Fire protection services are also provided to the City of Needles through a service contract. Ambulance transport service provided to Havasu Lake and paramedic service, is provided to Yucca Valley. Three voter approved special tax fire protection zones fund additional services to Wonder Valley, Havasu Lake and Twentynine Palms.	As of 2016, the PPC ratings for Fire Division 4 are 04/4X, Volunteer or paid call firefighter stations may have different ratings. Needles has a PCC Rating of 04/4Y; Yucca Valley 03/0X

Source: ISO, 2016; unless otherwise indicated

5.3.3 SERVICE CALLS

Calls for service vary among communities in San Bernardino County based on the diversity of its population, its built environment, and transportation system. Taken together, the SBCFD fields approximately 89,000 service calls each year, ranging from collisions to medical aid, to fires. Call volume has significantly increased over the past few years due primarily to medical calls. In 2014, medical aid

calls represented approximately 62 percent of all calls, which is similar to the national average of 60 percent according to surveys by the National Fire Protection Association.

Table 5-5 shows the types of service calls from FY2012–FY2014. Further detail by division is available in SBCFD's annual reports that can be found online.

Table 5-5. Fire Department Service Calls

	Fiscal Year 2013/14		Fiscal Year 2014/15		Fiscal Year 2015/16	
Reason for Call	Calls	Percent	Calls	Percent	Calls	Percent
Fires	1,931	2%	2,871	3%	3,052	3%
Medical Aid	47,724	61%	51,374	61%	54,785	62%
Traffic Collisions	3,863	51	4,030	5%	4,284	5%
HazMat Incidents	939	1%	1,182	1%	1,256	1%
Public Service	4,719	6%	6,351	8%	6,753	8%
Other Incidents	18,882	24%	17,742	21%	18,886	21%
Total	78,058	100%	83,695	100%	88,996	100%

Source: San Bernardino County Fire Department Annual Reports.
Fires include structural, vegetation, vehicle, and other fires (cooking, rubbish, storage, etc.).
HazMat Incidents include explosions, fireworks, hazardous materials such as chemical, biological, and electrical hazards with no fire involved.
Public Service calls include false alarm and weather related incidents.
Calls are anticipated to increase by an estimated 36,000 with the completion of the annexation of San Bernardino City and 29 Palms Fire Departments

In San Bernardino County, service calls are categorized into 32 groups and categorized by severity. Alpha calls (nonlife threatening situations requiring basic life support) represent 20 percent of all calls. Bravo calls represent 23 percent of all calls and are classified as possibly life threatening that require basic life support services. Charlie calls represent 24 percent of all calls, are considered life threatening, and require advanced life support. Delta calls represent 31 percent of all calls and are considered a serious life threat that requires advanced life support services. Echo calls (2 percent) are reserved for situations where life status is questionable and requires immediate aid from the closest resource.

According to SBCFD, service calls are anticipated to climb significantly over the next several years. With the annexation and assumption of San Bernardino and Twentynine Palms Fire Departments, the number of calls should increase by an additional 36,000 or 40 percent over current levels. Additional independent municipal fire departments may consider future consolidation into the SBCFD.

Providing effective and efficient response to fire emergencies has long been an issue in the county. With budget cuts in local municipalities, an increasing number of jurisdictions have closed fire departments and sought to be annexed into the County fire district. In the mid-2000s, the San Bernardino County LAFCO processed applications 3000 and 3001 to allow for the reorganization of the county fire department and expansion of service levels countywide.

During that reorganization and in the intervening years, the SBCFD has faced recurring issues and challenges in providing cost effective and reliable service.

- **Equipment and Staffing.** County Fire's staffing model calls for three-person paramedic engines operated by a Captain, Engineer, and a Firefighter Paramedic. This is generally below the NFPA standard for minimum staffing requirements for single–engine response to emergency fire situations. As of January 2017, there are four County Fire Stations staffed with only two personnel. This model presents constraints on desired service levels.

- **Rural Areas.** Many rural areas that receive fire and emergency medical services do not have an adequate tax base to sustain fulltime staffing. County Fire uses Paid Call Firefighters (PCFs) to assist in remote areas or handle calls themselves. There are unique challenges to addressing emergencies with PCFs. Response times are extended because they must drive to the station before responding to a call. They may have other commitments that make them unavailable.

- **Lack of Service Standards.** As part of the LAFCO reorganization, the SBCFD was encouraged to adopt different response standards tailored to different prototypical communities. Prototypical communities included rural/rural clusters, suburban/suburban cluster, urban/urban clusters, and even wilderness areas. This significant undertaking has not been implemented, although it remains important for the county and its varied communities.

- **Overlaps between fire service and ambulance transport.** The growth of the SBCFD has implications for coordinating ambulance transport and advanced life support services. San Bernardino County Board of Supervisors is currently initiating the process of reviewing exclusive operating areas and contracts of different ambulance transport companies. This may also have implications for LAFCO service reviews in the future.

- **Population growth.** Additional population growth in far-flung unincorporated communities with access issues will be increasingly hard to serve unless the tax base grows significantly or General Fund spending for additional Fire Department staffing and facilities is approved by the Board of Supervisors. Until communities reach a tipping point, where the base population is sufficient to be able to pay taxes to service a fire station, fire response will be challenging.

LAFCO is currently conducting their third cycle of municipal service reviews, including fire service. With the countywide plan and land use projections underway, it will become imperative to review fire service operations to ensure appropriate levels of service to communities throughout the county.

5.4 IMPLEMENTING AGENCIES

Fire service is provided by a variety of jurisdictions, including the federal government, state of California, San Bernardino County Fire District, special districts, and local governments. The following is a brief summary of each agency and their jurisdiction for fire protection and suppression services.

Federal Agencies

The federal government is the responsible for providing fire protection for most nonurban areas. The US Forest Service employs its own fire suppression specialists to protect its assets, including the San Bernardino National Forest, Angeles National Forest, and Joshua Tree National Forest. The National

Park Service is responsible for fire protection services in the Mojave National Preserve and Death Valley National Park. The US Fish and Wildlife Service employs its own fire suppression specialists to protect the nation's ecosystems and wildlife refuges, specifically the Lake Havasu Wildlife Preserve. The Bureau of Land Management has primary responsibility for fire suppression in the California Desert Conservation Areas. Figure 5-5 maps the location of areas covered by federal fire agencies.

CAL FIRE

The California Department of Forestry and Fire Protection (CAL FIRE) is responsible for the fire protection and stewardship of 31 million acres of California's privately owned wildlands. In addition, it provides emergency services in about 36 of the state's 58 counties via contracts. CAL FIRE's San Bernardino Unit serves four counties—San Bernardino, Los Angeles, Inyo, and Mono. CAL FIRE's operation fits generally into Schedule "A" or "B" classes. CAL FIRE's primary responsibility is to provide fire protection for SRAs, as defined by the Public Resource Code (Schedule B services). Schedule A services include contracts with local governments (cities, counties, and special districts). CAL FIRE contracts with the cities of Highland, Yucaipa, and San Bernardino for medical, structural, and wildland fire protection and has wildland fire protection agreements with Chino and Chino Hills.

San Bernardino County Fire

County Fire is an all-risk fire department providing emergency mitigation and management for fire suppression, emergency medical services (paramedic and non-paramedic), ambulance services, hazardous materials (HAZMAT) response, arson investigation, technical rescue, winter rescue operations, hazard abatement, and terrorism and weapons of mass destruction. A significant factor of County Fire's services/programs include Helicopter Rescue, Dozer, fire abatement Hand Crews, Inmate Hand Crew specialized program, and Honor Guard. County Fire also provides for the management of community safety services such as fire prevention, building construction plans and permits, household hazardous waste, local oversight and collection program for hazardous materials,

As of 2016, County Fire covers a territory of 16,500 square miles, and operates over 75 fire stations and 11 facilities that serve more than 60 unincorporated communities, the cities of San Bernardino, Twentynine Palms, Grand Terrace, and the Town of Yucca Valley. Additionally, County Fire provides fire protection services through contracts to five cities, which include Adelanto, Needles, Victorville, Hesperia, and Fontana's independent fire protection district. County Fire was reorganized pursuant to LAFCO Resolution 2997, which added additional areas of fire service.

Local Fire Agencies

Local agencies also provide a significant amount of fire protection service. Table 5-6 summarizes incorporated city fire departments and special districts that are outside of SBCFD jurisdiction with respect to fire services.

5. Fire Hazards

Table 5-6. Incorporated Fire Departments and Special Fire Jurisdiction

City/Community	Responsible Agency	Notes
Apple Valley	Apple Valley Fire Protection District	Also includes unincorporated areas south of Apple Valley
Arrowbear	Arrowbear Park Water District	Also includes unincorporated community of Arrowbear
Barstow	Barstow Fire Protection District	Also includes unincorporated communities of Lenwood and eastern portions of Hinkley
Big Bear	Big Bear Fire Department	Also includes unincorporated areas east of Big Bear
Chino/Chino Hills	Chino Valley Independent Fire Protection District	Also includes unincorporated areas southwest of Chino Hills
Colton	Colton Fire Department	
Daggett	Daggett Community Services District	
Highland	CAL FIRE/Highland Community Development	
Loma Linda	Loma Linda Fire Department	Also includes unincorporated areas within the Sphere of Influence of Loma Linda
Montclair	Montclair Fire Department	Also includes unincorporated area south of Montclair
Morongo Valley	Morongo Valley Community Services District	Also includes unincorporated community of Morongo Valley
Newberry Springs	Newberry Community Services District	Also includes unincorporated Newberry Springs
Ontario	Ontario Fire Department	
Rancho Cucamonga	Rancho Cucamonga Fire Protection District	
Redlands	Redlands Fire Department	
Rialto	Rialto Fire Department	
Running Springs	Running Springs Water District	Also includes unincorporated community of Running Springs
Twentynine Palms	Twentynine Palms Water District	Also includes unincorporated areas northwest of Twentynine Palms
Yermo	Yermo Community Services District	Also includes unincorporated community of Yermo

5.4.1 MULTI-JURISDICTIONAL COOPERATION

Wildfires often grow quickly, spread across jurisdictional boundaries, and require a tremendous amount of resources that are well beyond those of any single fire protection agency. Therefore, the County of San Bernardino maintains a robust system of mutual aid to suppress fires.

Volunteer and Private Mutual Aid

A significant component of the mutual aid system is volunteer and private agencies. These include agencies such as the American Red Cross and Salvation Army, who mobilize to provide assistance with mass care and sheltering. Many private agencies, churches, nonprofits, and other organizations offer assistance during emergencies. The California Disaster Corps maintains a program to train volunteers to assist in fire responsibilities in case of emergencies. The Emergency Communications Service is a volunteer group providing front-line communications and technical and logistical support to the San Bernardino County Fire Department and Office of Emergency Services. The Community Emergency Response Team Program educates people about disaster preparedness and provides training fire safety, light search and rescue, and disaster medical operations.

Mountain Area Safety Taskforce

The Mountain Area Safety Taskforce (MAST) is a coalition of federal, state, and local agencies and private-sector and volunteer organizations that works to prevent catastrophic wildfires. There are two divisions: San Bernardino County and Riverside County. One of the goals of MAST is the removal of overgrowth and dead trees, especially the victims of bark beetles. MAST also thins overgrown forests that are the result of decades of complete fire suppression. Thinning forested or chaparral land is an expensive, time- and labor-intensive process but necessary to return an ecosystem to a natural fire regime and to reduce the risk of catastrophic wildfire. MAST also educates the public about fire safety and the dangers of wildfires. MAST priorities include removing fuel from evacuation routes, refuge areas, and communication and essential service sites, and creating fire defense buffers. MAST has also developed evacuation plans and distributed emergency planning information to the public.

Statewide Mutual Aid

San Bernardino County participates in the California Disaster and Civil Defense Master Mutual Aid Agreement, which sets forth a framework for requesting and receiving mutual aid. Mutual aid exists for law enforcement, search and rescue, coroner, emergency managers, public works, and medical. The San Bernardino County Fire and Rescue Mutual Aid Operational Plan identifies the mutual aid system for the County, which includes 11 mutual aid zones, maps, communication protocols, and contact information. Mutual aid zones 1 to 6 are geographical; zones 7, 8, 9, and 10 are agency zones, since jurisdictional area may interface with more than one geographical zone; and Zone 11 consists of the state Office of Emergency Services equipment that is staged at departments from several zones. The Mutual Aid Operational Plan is designed to meet the anticipated needs of local agencies in their zones and to access resources of participating agencies to meet the needs of emergency incidents.

Table 5-7 details the plan's 11 mutual aid zones, participants, and resources available.

Table 5-7. Mutual Aid Zones in San Bernardino County

Mutual Aid Zone	Coverage Area	Participating Agencies	Equipment
1 – West Valley Area	West end of the San Bernardino Valley, generally west of Etiwanda Avenue	Chino Valley Fire Protection District San Bernardino County Fire Department Chino Institute for Men Fire Department Chino Institute for Woman Fire Department Montclair Fire Department Mt. Baldy Fire Department Ontario Fire Department Rancho Cucamonga Fire Protection District Upland Fire Department Ontario International Airport Fire Department	Types 1, 2, 3 and 4 engines, breathing support units, mobile communication units, field mobile mechanics, ALS and BLS squads, hazardous materials units, ALS and BLS rescues, MCI trailers, water tenders, truck companies and quints, light support units, foam units, air crash units, USAR units, and a bomb squad

5. Fire Hazards

Table 5-7. Mutual Aid Zones in San Bernardino County

Mutual Aid Zone	Coverage Area	Participating Agencies	Equipment
2 – East Valley Area	East end of the San Bernardino Valley, generally east of Etiwanda Avenue	Colton Fire Department Fontana Fire Department (Contract w/SBCFD) Highland Fire Dept. (Contract w/ CAL FIRE) Loma Linda Department of Public Safety Redlands Fire Department Rialto Fire Department San Bernardino County Fire Department San Bernardino City Fire Department San Manuel Fire Department Yucaipa Fire Dept. (Contract w/ CAL FIRE)	Type 1, 2, 3 and 4 engines, bulldozers with tenders, incident support vehicles, command posts, heavy equipment transports, utility transports, breathing support units, mobile communication units, MCI trailers, mobile mechanics, ALS and BLS squads, hazardous materials units, ALS and BLS rescues, water tenders, truck companies and quints, light support units, foam units, air crash units, and USAR units
3 – Mountains Area	Resort area of the San Bernardino Mountains, extending from Crestline through Big Bear	Big Bear Fire Authority Running Springs Fire Department Arrowbear Lake Fire Department San Bernardino County Fire Department	Type 1, 2, 3 and 4 engines, snow cats, breathing support units, ALS and BLS squads, ALS and BLS rescues, fire boats, MCI trailers, water tenders, and USAR units
4 – High Desert Area	Victor Valley, Barstow, Lucerne Valley, Searles Valley and Trona areas	Apple Valley Fire Protection District Barstow Fire Protection District China Lake Naval Air Weapons Station Daggett Community Service District Fort Irwin Fire Department Newberry Springs Community Service District Searles Valley Minerals Fire Dept. (Trona) San Bernardino County Fire Department Yermo Community Service District Barstow Marine Corps Logistics Base	Type 1, 2, 3 and 4 engines, breathing support units, ALS and BLS squads, ALS and BLS rescues, foam units, air crash units, truck companies, snow cat, hazmat units, field mobile mechanics, mobile communication units, MCI trailers, water tenders, and USAR units
5 – Morongo Basin Area	Morongo Basin area generally north of the Riverside County, east of Morongo Valley & northwest into Johnson Valley	Twentynine Palms Fire Department Twentynine Palms Combat Center Fire Department Morongo Valley Community Services District San Bernardino County Fire Department	Type 1, 2, 3 and 4 engines, breathing support units, BLS squads, BLS rescues, truck companies, hazmat units, MCI trailers, water tenders, and USAR units
6 – East Desert Area	Eastern desert regions of San Bernardino County	Baker Community Services District Needles Fire Department (Contract w/ San Bernardino County FD) San Bernardino County Fire Department	Type 1, 2, 3 and 4 engines, BLS rescues, MCI trailers, water tenders, and a fireboat
7 – San Bernardino County Fire Department	Approximately 18,821 square miles of San Bernardino County	San Bernardino County Fire Department	Airport rescue units, ambulances, boats, brush Engines (Type 3), brush patrols (Type 6), command posts, communication support vehicles, crew carriers, dozers, fire engines (Type 1 and Type 2), foam units, hazardous materials rigs, hazardous materials squads, ladder trucks, loaders, rescues, snow cats, squads, water tenders

Table 5-7. Mutual Aid Zones in San Bernardino County

Mutual Aid Zone	Coverage Area	Participating Agencies	Equipment
8 – United States Forest Service (USFS)	National Forest land in San Bernardino County	Rancho Cucamonga Fire Protection District Apple Valley Fire Protection District San Bernardino City San Bernardino County Big Bear Fire Authority Running Springs Highland and Yucaipa / CAL FIRE Colton Fire Department Loma Linda Fire Department Redlands Fire Department San Manuel Indian Reservation	Type 3 and 4 engines, water tenders, helicopters, bulldozers, air tankers, heli-tankers, and both hot-shot and standard hand crews
9 – Bureau of Land Management (BLM)	BLM Lands in San Bernardino County	CAL FIRE USFS/San Bernardino National Forest Joshua Tree National Park Death Valley Mojave National Preserve Apple Valley San Bernardino County	Type III engines, water tenders, and a type 2 water dropping helicopter with on-board fly crew available
10 – CAL FIRE	All resources and state responsibility areas protected by CAL FIRE – San Bernardino Unit	CAL FIRE	2 conservation camps and 6 fire stations in the county that house 8 hand crews, 11 engines, 1 bulldozer and 1 bulldozer tender during fire season, type 2 water dropping helicopter is available through CAL FIRE contract with the County Sheriff's Department. The helicopter and fly crew (inmate firefighters) are at the Prado Conservation Camp in Chino
11 – Office of Emergency Services (OES)	OES-owned fire and rescue resources that are operated by local agencies and can be mobilized during emergency situations throughout the state	Crest Forest Fire District San Bernardino County Fire Department Barstow Fire Department Colton Fire Department Montclair Fire Department Apple Valley Fire Protection District Ontario Fire Department Chino Valley Independent Fire District	Motorized fire equipment housed at participating agency stations

Source: San Bernardino County Fire Chief's Association 2014; San Bernardino County Fire 2015

6. EMERGENCY PREPAREDNESS

Prior chapters have discussed a variety of natural and man-made hazards in San Bernardino County. This chapter focuses on the management and prevention of emergencies and disasters and mitigation of potential risks to protect life, property, and public welfare.

6.1 INTRODUCTION

Emergencies can and do occur frequently throughout California, including San Bernardino County. The emergency may be a natural disaster or involve hazardous waste. Some man-made emergencies could develop from public-health incidents, major transportation accidents, or acts of terrorism. These events can strain the ability of local governments to effectively respond and recover, and require multijurisdictional responses to address disasters. In fact, over just the past 25 years alone, FEMA has declared at least 35 natural disasters in California, of which 16 have affected San Bernardino County. During that time, San Bernardino County has filed an additional 24 emergency requests for fire management assistance.

San Bernardino County's emergency preparedness system is extensive. This system includes the many critical facilities that provide important services, evacuation routes that are activated when an emergency occur, a system of ambulance providers to serve people in need, and a mutual aid system to draw upon to collectively respond to and support agencies during and after a disaster occurs.

This chapter on emergency preparedness supports the Countywide Plan and associated EIR. This chapter provides a general discussion of emergency preparedness and important components, including evacuation routes, mutual aid systems, and other pertinent information. The objective is to provide information on emergency preparedness concerns that will assist the County in making land use decisions, planning for service priorities, and protecting the health and welfare of the public.

This chapter relies on both literature and mapping. Sources of information for this assessment include the San Bernardino County Hazard Mitigation Plan, fire department annual reports, County Emergency Operations Plan, County Mutual Aid Services Plan, San Bernardino County ordinances, the 2007 General Plan, and the 2005 Safety Background Report, among others. A full listing of resources is included in Chapter 7. Information on law and justice services are found in a separate Regional Services Background Report. No fieldwork was performed for this section.

6. Emergency Preparedness

6.1.1 REGULATORY SETTING

Emergency and hazard mitigation planning are authorized by a variety of state and federal laws and administered by different governmental agencies. The following describes laws, regulations, policies, and agencies pertinent to the Safety Element of the General Plan and EIR.

Federal and State Law

Federal Disaster Mitigation Act of 2000

DMA 2000 (Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local, and tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for state, local, and tribal entities to coordinate mitigation planning and implementation efforts. A state hazard mitigation plan remains a condition for disaster assistance, with added incentives for increased coordination and integration of mitigation activities at the state level through the establishment of requirements for different levels of state plans. DMA 2000 also established a new requirement for local mitigation plans.

National Response Framework as amended

The Homeland Security Act directed the Department of Homeland Security to establish a framework to coordinate federal resources during emergencies. The National Response Plan (originally issued in 2004) was replaced in January 2008 by the National Response Framework and updated in May 2013. The Framework is implemented by FEMA. It is not a source of legal authority for incident response, but is used to guide response activities that arise from events of all sizes whether an emergency is declared or not. The Framework includes 15 emergency support function documents that detail the roles and responsibilities of governmental and private sector entities in key areas (e.g., transportation, communication, public safety). The emergency support function documents are intended to organize resources and services that are needed to save lives, protect property and the environment, restore essential services and critical infrastructure, and help victims and communities recover.

National Incident Management System

The National Incident Management System (NIMS) is a standardized approach to managing incidents that was developed by the Department of Homeland Security in 2004. It is a proactive approach to guide departments and agencies at all levels of government, nongovernmental organizations, and the private sector to work together seamlessly and manage incidents involving all threats and hazards, regardless of cause, size, location, or complexity. NIMS standard incident command structures are based on three organizational systems: the Incident Command System, the Multiagency Coordination System, and Public Information Systems. San Bernardino County follows NIMS procedures, as required by federal law. With this standardized method, it is possible to coordinate effectively the activities, responsibilities, roles, and resources of multiple jurisdictions.

6. Emergency Preparedness

California Regulatory and Planning Context

California Emergency Services Act of 1970

In 1970, the California Emergency Services Act superseded the California Disaster Act of 1945. The program reimburses local governments for the costs of certain emergency activities undertaken in response to a state of emergency proclaimed by the governor. The 1970 act established the Governor's Office of Emergency Services (Cal OES) to coordinate statewide emergency preparedness; post emergency recovery and mitigation efforts; and the development, review, approval, and integration of emergency plans. In 2009, amendments created the California Emergency Management Agency to consolidate emergency preparedness responsibilities and antiterrorism programs formerly administered by the California Office of Homeland Security.

Standard Emergency Management System

The Standardized Emergency Management System (SEMS) is the system required by Government Code Section 8607(a) for managing response to multi-agency and multi-jurisdiction emergencies. Its use is mandatory in order to be eligible for state funding of response-related personnel costs resulting from a disaster. SEMS consists of five organizational levels that are activated as necessary: field response, local government, operational area, region, and state. The SEMS framework includes the Incident Command System, multi-agency or inter-agency coordination, Master Mutual Aid Agreement and System, and the Operational Area concept. SEMS helps unify all elements of San Bernardino County's emergency management organization into a single integrated system.

Essential Services Building Seismic Safety Act of 1986

In 1986, the California Legislature determined that buildings providing essential services should be capable of providing services after a disaster. The Essential Services Buildings Seismic Safety Act requires such buildings to be "designed and constructed to minimize fire hazards and to resist the forces of earthquakes, gravity, and winds." "Essential services building" means any building designed and constructed for public agency use, or any building a portion of which is used or designed to be used as a fire station, police station, emergency operations center, California Highway Patrol office, sheriff's office, or emergency communication dispatch center. DSA is required to review and approve plans for buildings that provide essential services.

Emergency Medical Services

In 1966, the National Highway Safety Act charged the US Department of Transportation with developing emergency medical services systems standards and with assisting the states to upgrade the quality of their prehospital emergency care. This act, along with the 1973 Emergency Medical Services System Act, guided the early years of EMS growth at the regional, state, and local levels. Prior to 1980, California did not have a central state agency responsible for ensuring the development and coordination of EMS programs. In 1980, California's Emergency Medical Services System and Prehospital Emergency Care Personnel Act (SB 125) was signed, creating the state's Emergency Medical Services Authority and adding Division 2.5 to the California Health and Safety Code.

6. Emergency Preparedness

Local Regulatory and Planning Context

Emergency Operations Plan

The EOP provides a comprehensive emergency management framework for responding to any type of emergency that could impact the county. Individual communities may maintain similar plans or procedures for response to local incidents or initial activities prior to escalation to county scale. The EOP describes the roles and responsibilities of all county departments when responding to major emergencies and disasters, how the County will respond and the procedures involved during an emergency, and the roles other organizations may play (particularly through mutual aid agreements). The document also sets forth procedures that are intended to be compliant with SEMS and NIMS.

Multi-jurisdictional Hazard Mitigation Plan

San Bernardino County develops a local hazard mitigation plan. These plans identify hazards, assess the losses associated with the hazards, and investigate the vulnerability of the community to different hazards. These plans also identify alternatives for the future of the community to better prepare, minimize loss, and educate the public about the hazards identified. The San Bernardino County Multi-jurisdictional Hazard Mitigation Plan presents updated information regarding hazards being faced by the County, its fire protection district, flood control district, and Board-governed Special Districts. The multi-jurisdictional plan also presents tangible programs with mitigation measures to help reduce consequences from hazards, and outreach/education efforts in the unincorporated area.

Continuity of Operations Plan

A Continuity of Operations (COOP) Plan is scheduled for future development. The COOP plan details the processes for accomplishing administrative and operational functions (e.g., provision of water, wastewater service, energy provisions, etc.) during emergencies. Parts of this plan identify essential functions of local government, private sector businesses, and community services and delineate procedures to support their continuation. Each County department has prepared a COOP plan to ensure the continuity of actions and leadership during emergencies and natural or manmade disasters. As part of this effort, San Bernardino County is developing a recovery plan to provide for efficient coordination and policy guidance during the disaster recovery process. This plan will provide an organizational framework, policy guidance, and methods for use during the recovery process.

Flood Area Safety Task Force

The Flood Control District works with County OES, Sheriffs and Fire on the Flood Area Safety Task Force (FAST) to coordinate efforts by cities, county, state, federal, and non-profit agencies to provide for the protection of property owners, residents, and property subject to the risk of erosion, mudflows and flooding that could occur in the county with an initial emphasis on the threat resulting from fires. The Flood Area Safety Task Force came about due to the 2003 fires that ravaged the county and impeded the delivery of critical regional services.

6.1.2 IMPORTANT TERMS

The following important terms are used in this section.

Essential Facilities

Police stations, fire stations, emergency operations centers, schools (elementary, secondary, and postsecondary), medical facilities (e.g., hospitals, emergency clinics), and other resources that have a role in an effective and coordinated emergency response.

Catastrophe

Any natural or man-made incident, including terrorism that results in extraordinary levels of mass casualties, damage, or disruption, severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions.

Disaster

A major detrimental impact on the people, and the economic, social, and built environment of an area. The Stafford Act generally defines a major disaster as any natural catastrophe or, regardless of cause, any fire, flood, or explosion, which in the determination of the president causes damage of sufficient severity and magnitude to warrant major disaster assistance.

Hazard

Any event or physical condition that has the potential to cause fatalities, injuries, property damages, infrastructure damage, agricultural losses, damage to the environment, interruption of business or commerce, or other types of harm or loss. Hazards can be due to natural forces or human actions.

HAZUS

A GIS-based nationally standardized loss estimation tool developed and used by FEMA. It is used to estimate potential losses due to flooding and earthquakes, particularly for natural hazard mitigation plans. It does not estimate losses due to urban or wildland fires. HAZUS is used frequently in hazard mitigation planning to obtain a magnitude-of-order estimate of potential losses due to disasters.

Incident

An occurrence or event, natural or man-made, which requires a response to protect life or property. Incidents can include major disasters, emergencies, terrorist attacks, terrorist threats, civil unrest, wildland and urban fires, floods, hazardous materials spills, nuclear accidents, aircraft accidents, earthquakes, hurricanes, tornadoes, tropical storms, tsunamis, war-related disasters, public health and medical emergencies, and other occurrences requiring an emergency response

Lifeline Facilities

Any continuously engineered system providing transportation, communications, water, power, or other distributed service. This may include electrical utilities; pipeline networks; water supply, wastewater treatment, and disposal systems; dams, reservoirs, aqueducts, and levees; petrochemical facilities; solid waste disposal systems; transportation systems; and communications systems.

Master Mutual Aid Agreement

An agreement entered into by and between the State of California, its departments and agencies, and the various special districts, cities, counties, and other public agencies to assist each other, upon request, by providing resources to combat or prevent any type of emergency or disaster.

National Incident Management System

A systematic, proactive approach guiding government agencies at all levels, the private sector, and nongovernmental organizations to work seamlessly to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life or property and harm to the environment.

Resilience

The ability of a system to absorb shock and maintain its structure and functions with a minimum of loss and recover to prevent functionality in a relatively short time. Typically, the term resilience refers to the capacity of a community, region, or state to: 1) survive a major disaster; 2) retain its essential structure and functions; and 3) adapt to post-disaster opportunities for transforming itself to meet new challenges.

Standardized Emergency Management System

Standardized emergency management system (SEMS) is a structure for coordination between the government and local emergency response organizations. It provides and facilitates the flow of emergency information and resources within and between the organizational levels of field response, local government, operational areas, regions and state management. It is a system required by California Government Code for managing response to multi-agency and multi-jurisdiction emergencies in California. SEMS consists of five organizational levels that are activated as needed: field response, local government, operation area, region, and state.

Terrorism

Defined by the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." Terrorism may include the use of weapons of mass destruction, including biological, chemical, nuclear and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage; intentional hazardous material releases; etc.

6.2 EMERGENCY PREPAREDNESS

San Bernardino County's emergency preparedness approach is described in various plans. This section highlights the general phases of the emergency preparedness system and provides an inventory of public facilities, critical infrastructure, lifeline services, evacuation routes, and mutual aid agreements that support the County's emergency preparedness system. Emergency management can be categorized into a series of phases.

Preparedness

San Bernardino County adheres to NIMS for emergency preparedness. NIMS is a systematic approach for government, nongovernmental organizations, critical infrastructure owners and operators, and the private sector to work together to manage threats and natural and man-made hazards. The NIMS provides a comprehensive and standardized incident management system for agencies that are involved in emergency management and/or incident response. San Bernardino County is NIMS-compliant, as articulated in its EOP, and therefore eligible for federal preparedness grants and award.

Response Phase

The response phase includes activities that address the short-term, direct effects of an incident. The County follows SEMS to structure its response phase. Adopted by California, SEMS unifies all elements of emergency management into a single integrated and standardized system. SEMS incorporates an incident command system, field-level emergency response system, multi/inter-agency coordination, mutual aid, and operational area concepts. San Bernardino County is SEMS compliant and therefore eligible for reimbursement of response-related costs under state disaster assistance programs.

Recovery Phase

Recovery programs provide relief to individuals and communities stricken by an emergency and restore public services to a state of normalcy. Recovery efforts include damage assessments and the actions necessary to return health and safety systems (e.g., water, electricity, and food) and services (e.g., acute health care and law enforcement) to a community's minimum operating standards. Successful recovery activities result in the restoration of government operations, business, reconstruction of public buildings and infrastructure, and the rebuilding of impacted communities. County staff also complete damage assessment and after-action reports as part of the recovery phase.

Hazard Mitigation

Mitigation planning includes a review of ways to avert future emergencies and reduce the impact of future disasters. Specific hazard mitigation plans are prepared subsequent to a federally declared disaster. They reflect the current risk analysis and mitigation priorities specific to the declared disaster. Mitigation efforts include, but are not limited to amending local ordinances (e.g., zoning, building codes, and other enforcement codes), initiating structural retrofitting measures, assessing tax levies or abatements, emphasizing public education and awareness, or undertaking capital improvements.

6.2.1 CRITICAL FACILITIES

Critical facilities are facilities important to the San Bernardino County community. They include essential facilities, transportation systems, lifeline utility systems, and high potential loss facilities. Although grouped and defined in different ways, the following are common definitions.

- **Essential Facilities** are essential to the health and welfare of the whole population, particularly following a disaster. They include hospitals and other medical facilities, police and fire stations, emergency operations centers and evacuation shelters, and schools.

6. Emergency Preparedness

- **Transportation Systems** include airways–airports, airstrips, and heliports; highways–bridges, tunnels, roadbeds, overpasses, and transfer centers; railways–trackage, tunnels, bridges, railyards, and depots; waterways–canals, locks, seaports, ferries, harbors, drydocks, and piers.
- **Lifeline Utility Systems** such as potable water, wastewater, oil, natural gas, electric power, and communication systems. This includes such facilities as electrical sub stations, water treatment facilities, telephone central offices, and wastewater facilities.
- **High Potential Loss Facilities** are facilities that would have a high loss associated with them. These may include dams, military installations, facilities housing hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.

Table 6-1 lists the number and types of facilities vulnerable to disasters in San Bernardino County based on analysis completed for the Multijurisdictional Hazard Mitigation Plan. This includes facilities located in inundation paths, very high fire severity zones, geologic and seismic hazard zones, and other hazards. This list does not include high loss properties such as large apartment structures, senior homes, or other types of facilities where significant loss could occur due to a natural disaster.

Table 6-1. Critical Facilities Vulnerable to Hazards in Unincorporated San Bernardino County

Types of Critical Facilities			
Essential Facilities	High Potential Loss Facilities	Transportation Systems	Lifeline Utility Systems
1 Emergency Operations Center	751 Hazardous Material Sites	553 Highway Bridges	40 Communications Facilities
99 Fire Stations	24 Dams/Reservoirs	70 Airport Facilities	13 Electric or Natural Gas Utility
28 Police Stations	90 Vulnerable residential facilities	2 Bus Facilities	3 Potable Water Facilities
130 Schools	91 Child care centers	11 Railway Bridges	2 Waste Water Facility
9 Hospitals			

Source: 2017 San Bernardino County Multi-jurisdictional Hazard Mitigation Plan, Dynamic Planning and Science, 2017

The San Bernardino County Hazard Mitigation Plan contains an inventory of all critical facilities and an itemization of the costs associated with damages for facilities subject to natural hazards. Figure 6-1 on the following page details the location of all critical facilities in San Bernardino County.

Figure 6-1 Critical Facilities

6. Emergency Preparedness

This page left intentionally blank

6.2.2 EMERGENCY SERVICES

In 1980, California's Emergency Medical Services System and Prehospital Emergency Care Personnel Act (SB 125) created the state's Emergency Medical Services Authority and added Division 2.5 to the California Health and Safety Code. Division 2.5 allows each county to develop an emergency medical services program, and requires the county to designate a Local Emergency Medical Services Agency (LEMSA). The Inland Counties Emergency Medical Agency (ICEMA) is the LEMSA for San Bernardino County. ICEMA is a joint powers agency in a partnership with Inyo and Mono Counties.

ICEMA's mission is driven by state mandates codified in Section 1797.222 of the Health and Safety Code to provide quality and appropriate medical care in receiving care from prehospital emergency medical personnel. ICEMA's mission statement is to ensure an effective system of quality patient care and coordinated emergency medical response by planning, implementing and evaluating an effective emergency medical services system including fire department and public ambulances, prehospital providers and hospitals, including specialty care hospitals, such as trauma and cardiac care hospitals.

San Bernardino County has 26 total Exclusive Operating Areas (EOAs) for ambulance service designated as urban, rural, or wilderness areas. Ambulance service for these areas is provided by private companies, fire districts, or by public or volunteer fire departments. All private providers are required to enter into a performance-based contract; public providers must enter into a MOU. However, not all areas of the County are included in EOAs. State law allows a grandfather clause to permit cities and districts already operating emergency service programs as of June 1980 to continue.

ICEMA requires ambulance providers to meet a variety of requirements as a condition for providing service within their EOA. A critical requirement for ambulance providers is adherence to specific response times to emergencies. Although variations exist depending on the region of the county and its urban, rural, or wilderness terrain, ambulance transport services are generally required to provide advanced life support service at the scene within 9 minutes and 59 seconds, 90% of the time. Performance reports for each of the ambulance transport agencies are listed on ICEMA's website.

In 2017, the San Bernardino County Board of Supervisors has initiated a process to review EOAs. This review was initiated in response to the need or periodic review of the overall ambulance transport system to ensure that the current framework meets the long-term needs of the county. Figure 6-2 provides maps detailing the location and extent of each EOA.

6.2.3 EVACUATION ROUTES

The potential for large-scale disasters necessitates the identification of evacuation routes for use during wildfire, flooding, earthquake, or other natural disasters. The 2007 General Plan identifies evacuation routes based on their location and ability to provide adequate capacity for residents living in the Valley, Mountain, and Desert regions. The identified routes consist mostly of interstate freeways and state highways; however, these roads are not meant to be a comprehensive evacuation plan. Specific

6. Emergency Preparedness

evacuation routes would be designated during an emergency by the San Bernardino County Sheriff's Department in accordance with the County's emergency management plan.

Table 6-2 displays the evacuation routes in San Bernardino identified during the 2007 General Plan update. The vast majority of these routes are assumed to still be relevant.

Table 6-2. Evacuation Routes in San Bernardino County

	Region		
Type of Evacuation Route	Valley Region	Mountain Region	Desert Region
Interstate Freeways	I-10; I-15; I-215	none	I-15; I-40; US-395; US-95
State Highways	SR-60; SR-66; SR-71; SR-330; SR-83; SR-142	SR-2; SR-18; SR-38; SR-138; SR-173; SR-330	SR-18, SR-58, SR-62, SR-127, SR-95; SR-138, and SR-247
Major and Secondary Highways	Yes See cities for locations	Yes See cities for locations	Yes See cities for locations

Source: Circulation and Infrastructure Existing Conditions Report, 2007

The Mountain Area Safety Taskforce has created emergency evacuation route maps to help residents of the Mountain Region prepare for emergencies. The maps are intended to support pre-emergency identification of options for ingress and egress in the Mountain Region. The specific emergency routes employed in the case of an actual emergency will be designated by evacuation authorities based on emergency conditions and will be communicated to residents at the time of the emergency.

Critical Route Planning Committee

San Bernardino County Fire Protection District Office of Emergency Services has a "Critical Route Planning Committee" that is developing countywide routes and alternate routes for use in evacuating residents from a disaster area while simultaneously allowing first responders' access into a disaster area without congestion and gridlock. The committee members are from County departments, city and town representatives, and key state and federal agencies. The Critical Route Planning effort is being coordinated with surrounding counties to prevent congestion and gridlock at the county boundaries.

Figure 6-3 shows the location of major evacuation routes in the county.

Figure 6-2 Ambulance Transport Service Exclusive Operating Areas

6. Emergency Preparedness

This page left intentionally blank

Figure 6-3 Evacuation Routes

6. Emergency Preparedness

This page left intentionally blank

6.2.4 MUTUAL AID

Beyond the fire mutual aid framework described earlier, the County has an expanded network of organizations and agencies capable of providing a full range of emergency services for a range of natural and manmade disasters. This framework is described below.

California Disaster and Civil Defense Master Mutual Aid

The master mutual aid agreement creates a formal structure wherein each jurisdiction retains control of its own facilities, personnel, and resources, but may also receive or render assistance to other jurisdictions. State government is obligated to provide available resources to assist local jurisdictions in emergencies. It is the responsibility of local jurisdictions to negotiate, coordinate, and prepare mutual aid agreements. Mutual aid assistance may be provided under one or more of the following plans:

- Law Enforcement Mutual Aid Plan
- Search and Rescue Mutual Aid Plan
- Coroner Mutual Aid Plan
- Urban Search and Rescue Mutual Aid Plan
- Emergency Managers Mutual Aid Plan
- Public Works Mutual Aid Plan
- California Medical Mutual Aid Plan

Interstate Mutual Aid

Mutual aid may also be obtained from other states. California is a member of the interstate Emergency Management Assistance Compact (EMAC), a congressionally ratified organization that provides form, structure, and procedures for rendering emergency assistance between states. After a state of emergency declaration, California can request and receive reimbursable assistance through EMAC from other member states quickly and efficiently without issues of liability. Cal OES and the state's EMAC Coordinator are responsible for facilitating requests for assistance pursuant to EMAC.

Volunteer and Private Mutual Aid

Volunteer and private agencies have a significant role in the mutual aid system. Agencies such as the American Red Cross and Salvation Army provide assistance with mass care and shelter. Many private agencies, churches, nonprofits, and other entities offer assistance during emergencies. The California Disaster Corps trains volunteers to assist in fire responsibilities in case of emergencies. The Emergency Communications Service is a volunteer group providing front-line communications, technical, and logistical support to the County fire department and Office of Emergency Services. The Community Emergency Response Team Program educates people about disaster preparedness and provides training in fire safety, light search and rescue, and disaster medical operations.

6.3 RESPONSIBLE AGENCIES

San Bernardino County Fire Department, Office of Emergency Services

The Office of Emergency Services (OES), a division of the San Bernardino County Fire Department, is responsible for countywide emergency planning, mitigation, response, and recovery activities. The OES works with all County departments, all 24 cities, and many nongovernment organizations. In the event of an emergency, the OES manages the County's emergency operations center and coordinates with the County's disaster response expenses for recovery from state and federal governments. OES management is responsible for the day-to-day administration of the County's disaster preparedness and response program and development of the County's emergency operations plan. One of the primary functions is to ensure that the emergency operations center is in a constant state of readiness.

SBCFD is an all-risk department providing emergency mitigation and management for fire suppression; emergency medical services; ambulance services; HAZMAT response; arson investigation; technical rescue including water borne, flooding and mudslide; winter rescue operations; and terrorism and weapons of mass destruction. As part of disaster preparation, response, and mitigation, the department's OES specifically provides support and assistance to the 24 cities and towns, as well as, all the unincorporated portions of the county. SBCFD also provides for the management of community safety services such as: fire prevention, building construction plans and permits, household hazardous waste, Local Oversight Program for hazardous materials, HAZMAT facility inspections, planning and engineering, and public education and outreach.

The California Emergency Services Act designates each county as an operational area (OA) to coordinate emergency activities and resources of the many cities, special districts, and other political subdivisions within the boundaries of each county. The governing bodies of political subdivisions in each county establish the OA lead agency to coordinate between local, regional, and state governments. OA responsibilities include coordinating with organizations to deploy field level emergency response personnel, activate emergency operations centers, and issue orders to protect the public. The County OES is the designated OA lead agency responsible for disaster planning and emergency management coordination throughout the San Bernardino County Operational Area.

Community Organizations Active in Disaster/San Bernardino County Voluntary Organizations Active in Disaster

Community Organizations Active in Disaster (COAD) is an organization based in a community or geographic area that includes representatives from public, private, nonprofit, and faith-based agencies, community groups, and businesses. Their mission is to strengthen area-wide disaster coordination and enhance the community's ability to prepare, respond, recover, and mitigate. Due to the geographic size of the county, the San Bernardino County Voluntary Organizations Active in Disaster comprises six regional COADs: Big Bear Valley, East End, High Desert, Morongo Basin, Rim Communities, and West End. Having the six regional COADs ultimately strengthens the resources available countywide. Each COAD works in coordination with OES and local emergency management. COADs also work in collaboration with the San Bernardino County Voluntary Organizations Active in Disaster.

Community Emergency Response Team

The Community Emergency Response Team (CERT) Program educates people about disaster preparedness and trains them in basic response skills. Following a catastrophic event CERT Members can assist themselves, their families, and others in their neighborhood or workplace until professional responders arrive. Fourteen (14) CERT programs are in the communities listed below.

Table 6-3. CERT Teams in San Bernardino County

Angelus Oaks	Lytle Creek	Oak Hills	Silver Valley
Big Bear Valley	Mill Creek Canyon	Phelan/Pinon Hills	Wrightwood
Helendale	Morongo Basin	Rosena Beach	
Lucerne Valley	Mountain	San Antonio Heights	

The SBCFD Office of Emergency Services has sworn in over 1,000 CERT participants as California Disaster Service Workers. The program receives guidance and resources from Department of Homeland Security, FEMA, Citizen Corps, and California Volunteers. The program is administered locally by the San Bernardino County Fire Protection District Office of Emergency Services.

California Office of Emergency Services (CAL-OES)

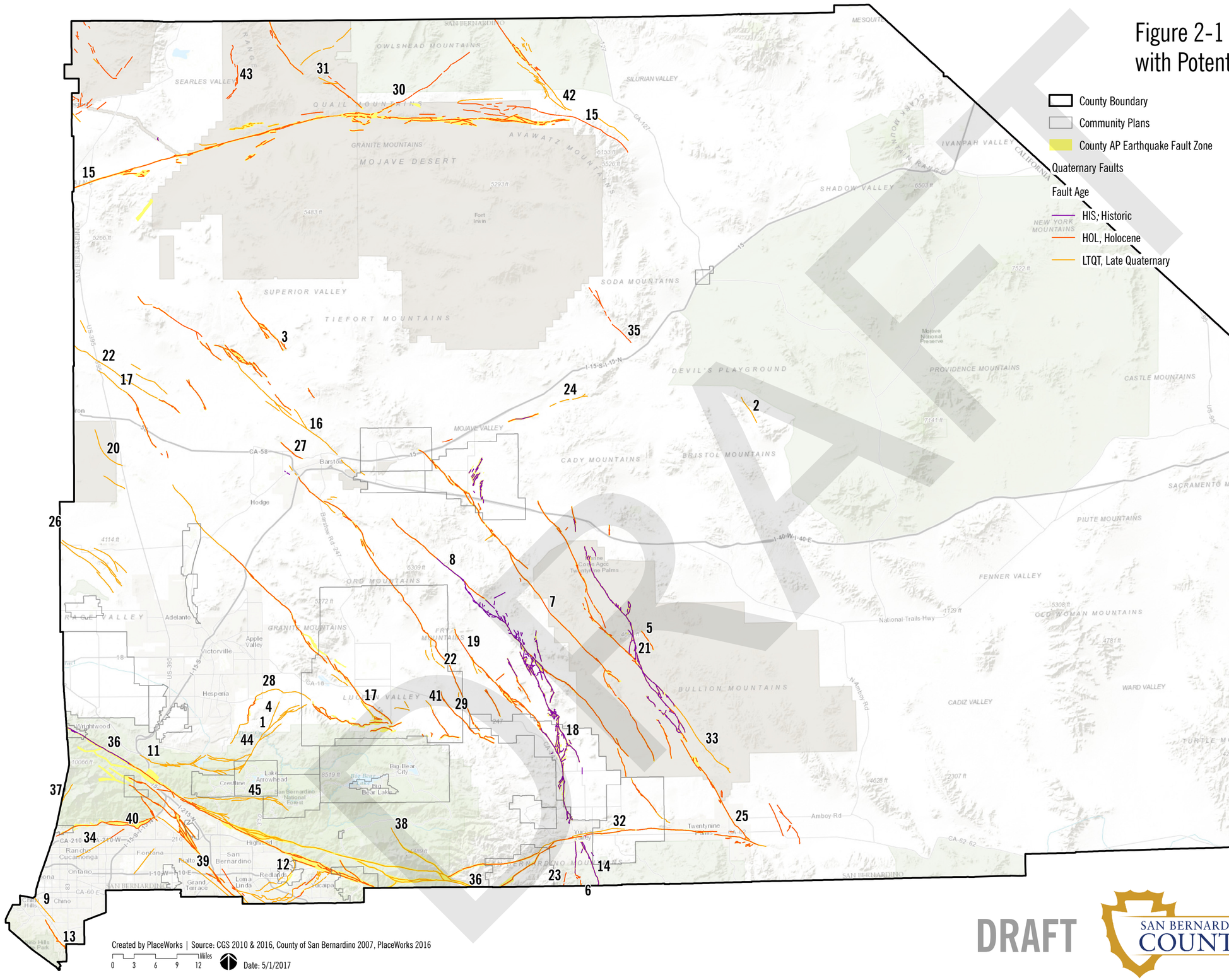
CAL-OES is responsible for the coordination of overall state agency response to disasters, assuring the state's readiness to respond to, recover from all hazards and assisting local governments in their emergency preparedness, response, recovery, and mitigation. CAL-OES is responsible for developing the statewide hazard mitigation plan. Among its many functions are the following:

- Managing communications assets and systems that support the statewide network of satellite, land, mobile radio, and the fleet of communication vehicles that provide disaster services support statewide
- Developing and maintaining state-level emergency plans and guidance to ensure consistency in disaster planning at all levels of government and community
- Coordinating with local, state, federal, and voluntary/nonprofit partners to administer recovery operations in the event of a disaster
- Coordinating statewide response of fire and rescue mutual aid resources to all types of emergencies, including hazardous materials.

6. Emergency Preparedness

This page left intentionally blank

Figure 2-1 Alquist Priolo Zones and Fault Zones with Potential for Magnitude 5+ Earthquakes



County Boundary

Community Plans

County AP Earthquake Fault Zone

Quaternary Faults

Fault Age

- HIS, Historic
- HOL, Holocene
- LTQT, Late Quaternary

Label	Fault Name
1	Arrastre Canyon Narrows
2	Baker
3	Blackwater
4	Bowen Ranch
5	Bullion Mountains
6	Burnt Mountain
7	Calico-Hidalgo
8	Camp Rock-Emerson-Copper Mountain
9	Central Avenue
10	Chemehuevi Graben
11	Cleghorn
12	Crafton Hills
13	Elsinore (Chino)
14	Eureka Peak
15	Garlock
16	Harper
17	Helendale-South Lockhart
18	Homestead Valley
19	Johnson Valley
20	Kramer Hills
21	Lavic Lake
22	Lenwood-Lockhart
23	Long Canyon
24	Manix
25	Mesquite Lake
26	Mirage Valley
27	Mt. General
28	North Frontal
29	Old Woman Springs
30	Owl Lake
31	Panamint Valley
32	Pinto Mountain
33	Pisgah-Bullion
34	Red Hill-Etiwanda Avenue
35	Red Pass
36	San Andreas
37	San Antonio
38	San Gorgonio Mountain
39	San Jacinto
40	Sierra Madre (Cucamonga)
41	Silver Reef
42	Southern Death Valley
43	Tank Canyon
44	Tunnel Ridge
45	Waterman Canyon fault zone

Created by PlaceWorks | Source: CGS 2010 & 2016, County of San Bernardino 2007, PlaceWorks 2016

0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 2-2 Liquefaction and Landslide Susceptibility

County Boundary
Community Plans
Rockfall/Debris-Flow Hazard Area

Generalized Liquefaction Susceptibility

Liquefaction Rating

- High
- Medium
- Low
- Mapped, Existing Landslide

Generalized Landslide Susceptibility

Susceptibility

- Moderate to High
- Low to Moderate

Created by PlaceWorks | Source: County of San Bernardino 2016

0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 2-3 Land Subsidence Potential

County Boundary
Regional Boundaries

Reported_Subsidence_Location

Id

- Recent subsidence
- Historical and recent subsidence
- Historical subsidence

Estimated_Potential_Subsidence_20140807

Summary_Ranking

- Insufficient Data
- Low
- Medium to Low
- Medium to High
- High

Created by PlaceWorks | Source: DWR 2016 (Service:gis.water.ca.gov/Public/Subsidence)

0 3 6 9 12 Miles

Date: 10/25/2016

DRAFT

SAN BERNARDINO COUNTY

COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-1 General Waterways

County Boundary
Community Plans
Channels

USA Stream - Stream Level

1
2
3
4
5
6 - 10
11 - 17

NHD Waterbody

Lake
Playa
Reservoir
Marsh

Created by PlaceWorks | Source: DWR 2015, Esri 2016, County of San Bernardino 2015

0 3 6 9 12 Miles

Date: 5/1/2017

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-2a Dam and Basin Hazards - Countywide

County Boundary
Community Plans
Dam Inundation Areas

Dam Jurisdiction
Federal
State Govt.
County of SB
Local Govt.
Public Utility
Private

Hazard Potential
High
Significant
Low
N/A

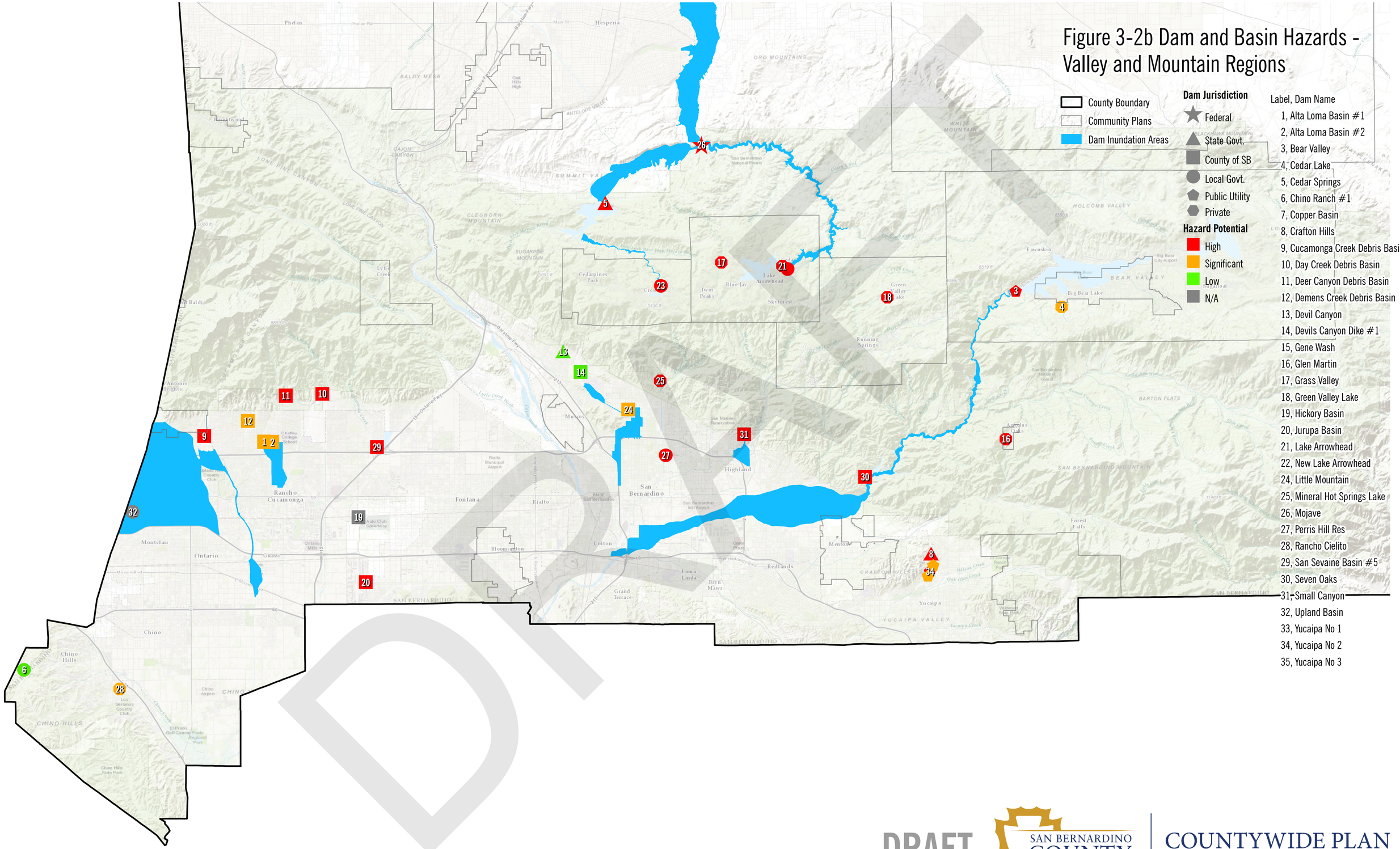
Label, Dam Name
1, Alta Loma Basin #1
2, Alta Loma Basin #2
3, Bear Valley
4, Cedar Lake
5, Cedar Springs
6, Chino Ranch #1
7, Copper Basin
8, Crafton Hills
9, Cucamonga Creek Debris Basin
10, Day Creek Debris Basin
11, Deer Canyon Debris Basin
12, Demens Creek Debris Basin
13, Devil Canyon
14, Devils Canyon Dike #1
15, Gene Wash
16, Glen Martin
17, Grass Valley
18, Green Valley Lake
19, Hickory Basin
20, Jurupa Basin
21, Lake Arrowhead
22, New Lake Arrowhead
24, Little Mountain
25, Mineral Hot Springs Lake
26, Mojave
27, Perris Hill Res
28, Rancho Cielito
29, San Sevaine Basin #5
30, Seven Oaks
31, Small Canyon
32, Upland Basin
33, Yucaipa No 1
34, Yucaipa No 2
35, Yucaipa No 3

Created by PlaceWorks | Source: ACOE 2016, County of San Bernardino 2007
0 3 6 9 12 Miles
Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-2b Dam and Basin Hazards - Valley and Mountain Regions



SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-3a Levees - Countywide

- County Boundary
- Community Plans
- Levee Centerline
- Leveed Area

Created by PlaceWorks | Source: ACOE 2016 (service: http://geo.usace.army.mil/cgi-bin/wms/nldwms?)

0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-3b Levees - Valley and Mountain Regions

County Boundary
Community Plans
Levee Centerline
Leveed Area

Created by PlaceWorks | Source: ACOE 2016 (service: http://geo.usace.army.mil/cgi-bin/wms/nldwms?)

0 3 6 9 12 Miles

Date: 5/1/2017

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 3-4 Flood Hazards

County Boundary

Community Plans

Flood Zone

100-Year FEMA Flood (1% Annual Chance Flood Hazard)

500-Year FEMA Flood (0.2% Annual Chance Flood Hazard)

100-Year DWR Awareness*

* 100-Year Flood Hazard areas using approximate assessment by DWR; not FEMA regulatory floodplain maps.

Created by PlaceWorks | Source: FEMA 2015, DWR 2016

0 3 6 9 12 Miles

Date: 5/1/2017

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 4-1 Waste Disposal and Landfill Sites

County Boundary

Community Plans

CalRecycle SWIS (180 locations)

Calrecycle - OpStatus

- Absorbed
- Active
- Clean Closed
- Closed
- Inactive
- Planned

landfill - ISD 160809 (103 locations)

ISD Landfill Sites - TYPE, STATUS

- ALK. DUST DISP., NON-COUNTY
- BRINE DISPOSAL, NON-COUNTY
- COLLECTION CENTER (LVTO), ACTIVE
- DISPOSAL SITE, NON-COUNTY
- DUMP, NON-COUNTY
- JET LANDFILL, NON-COUNTY
- LANDFILL, ACTIVE
- LANDFILL, CLOSED
- LANDFILL, INACTIVE
- LANDFILL, NON-COUNTY
- LANDFILL, PROPOSED
- MRF, ACTIVE
- QUARRY DUMP, NON-COUNTY
- QUARRY WASTE, NON-COUNTY
- RECLAIMATION FIL, NON-COUNTY
- SUPERIOR SITE, NON-COUNTY
- TAILINGS DUMP, NON-COUNTY
- TRANSFER STATION, ACTIVE
- TRANSFER STATION, NON-COUNTY

Created by PlaceWorks | Source: County of San Bernardino 2016, CalRecycle 2016

0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 5-1 Fire History in San Bernardino County

County Boundary
Community Plans

BLM/Calfire - Acreage Burned
- 50,001 - 91,428
- 10,001 - 50,000
- 1001 - 10,000
- 101 - 1,000
- 11 - 100
- 0 - 10

Calfire - Times Burned
- 10 - 12
- 9
- 8
- 7
- 6
- 5
- 4
- 3
- 2
- 1

Created by PlaceWorks | Source: PlaceWorks 2016, BLM 2015, Calfire 2015

0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 5-2 Fire - Vegetative Fuel Model Types

County Boundary
Community Plans

Fuel Model

- 1 Grass
- 2 Pine/Grass
- 3 Tall Grass
- 4 Tall Chaparral
- 5 Brush
- 6 Dormant Brush
- 7 Southern Rough
- 8 Hardwood/Lodgepole Pine
- 9 Mixed Conifer Light
- 10 Mixed Conifer Medium
- 11 Light Logging Slash
- 12 Medium Logging Slash
- 15 Desert Fuel (Custom 15)
- 28 Urban Fuel (Custom 28)
- 97 Agricultural Lands
- 98 Water
- 99 Barren/Rock/Other

Created by Dudek | Source: Calfire 2014

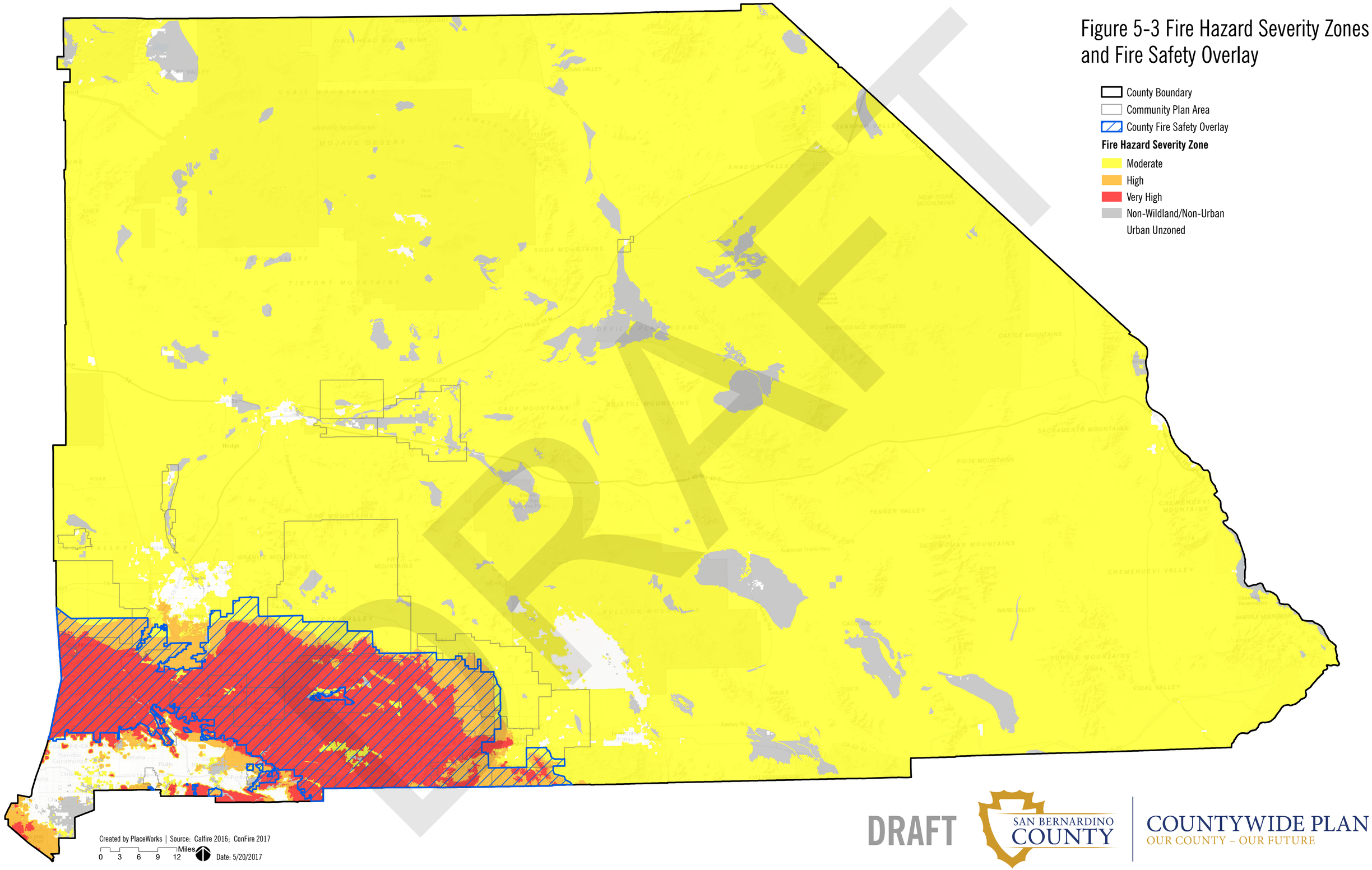
0 3 6 9 12 Miles

Date: 5/1/2017

SAN BERNARDINO COUNTY

COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 5-3 Fire Hazard Severity Zones and Fire Safety Overlay



SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 5-4 Fire Responsibility Areas - Local, State, and Federal

County Boundary
Community Plans

Calfire 2016 Fire Protection Responsibility Area

Local Responsibility Area (LRA)
State Responsibility Area (SRA)
Federal Responsibility Area (FRA)

Created by PlaceWorks | Source: Calfire 2016

0 3 6 9 12 Miles

Date: 5/1/2017

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

Figure 6-1 Critical Facilities

- County Boundary
- Community Plans
- Fire Stations
- Hospitals
- County Buildings
- Sewage Treatment
- School Sites

Created by PlaceWorks | Source: County of San Bernardino 2015

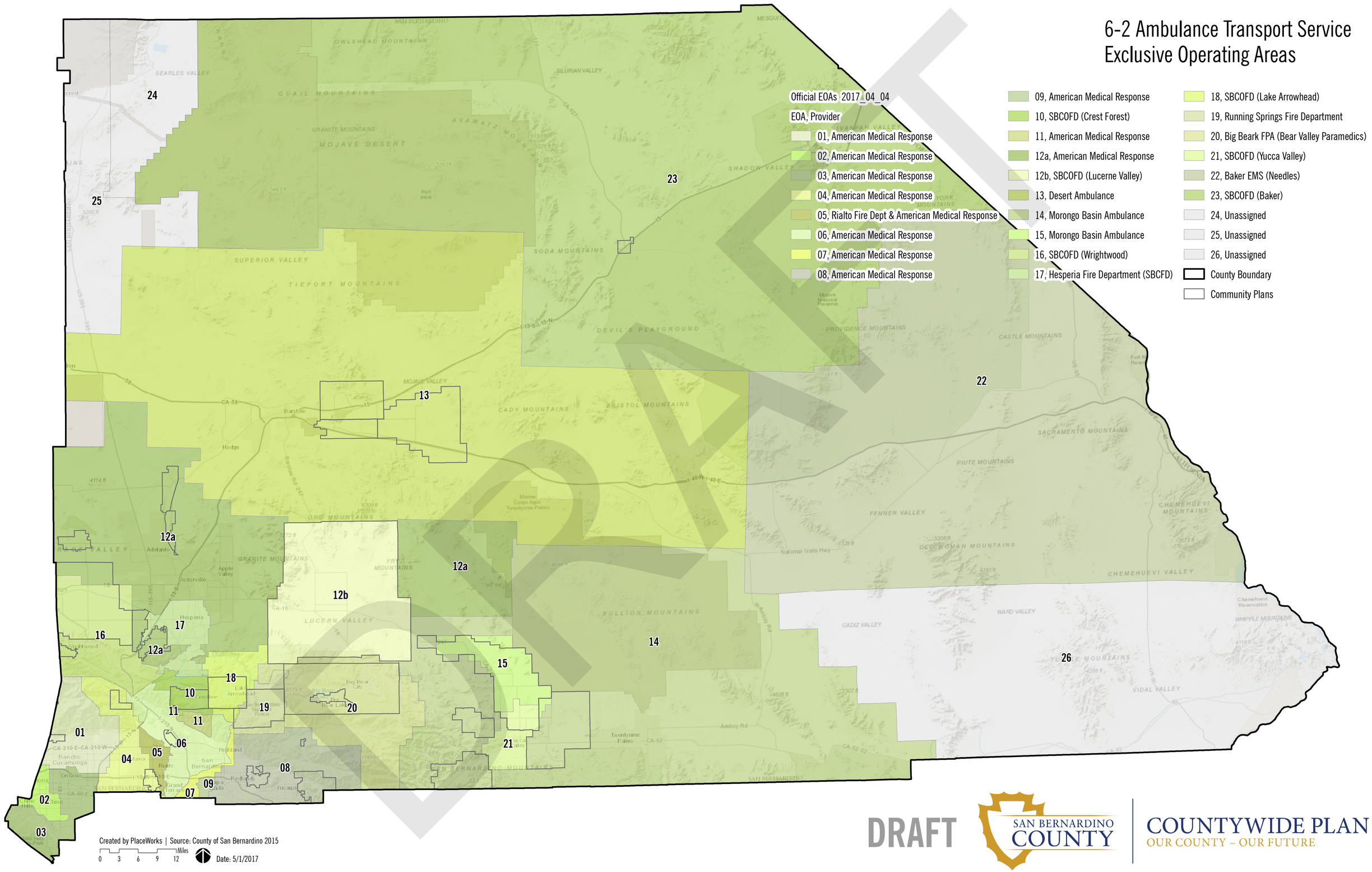
0 3 6 9 12 Miles

Date: 5/1/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

6-2 Ambulance Transport Service Exclusive Operating Areas



DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE

6-3 Evacuation Routes

County Boundary
Community Plans
Evacuation Routes

Note: Evacuation Routes not shown include major and secondary highways throughout incorporated and unincorporated areas of the county.

Created by PlaceWorks | Source: County of San Bernardino 2015
0 3 6 9 12 Miles
Date: 5/4/2017

DRAFT

SAN BERNARDINO COUNTY | COUNTYWIDE PLAN
OUR COUNTY – OUR FUTURE