5.6 GEOLOGY AND SOILS

This section of the draft program environmental impact report (PEIR) evaluates the potential for implementation of the San Bernardino Countywide Plan (CWP or Project) to impact geological and soil resources in the County of San Bernardino (County). The analysis in this section is based in part on the following technical report:

- *County of San Bernardino Safety Background Report*, PlaceWorks in collaboration with Dudek, April 5, 2017.

A complete copy of this study is included in the Technical Appendices to this Draft EIR (Appendix G).

5.6.1 Environmental Setting

5.6.1.1 REGULATORY BACKGROUND

Federal

Clean Water Act

The federal Water Pollution Control Act of 1948, as amended in 1972, (33 USC § 1251 et seq.)(also known as the Clean Water Act [CWA]) is the principal statute governing water quality. The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and gives the US Environmental Protection Agency (EPA) the authority to implement pollution control programs, such as setting wastewater standards for industry. The statute's goal is to end all discharges entirely and to restore, maintain, and preserve the integrity of the nation's waters. The CWA regulates both direct and indirect discharge of pollutants into the nation's waters. The CWA sets water quality standards for all contaminants in surface waters and makes it unlawful to discharge any pollutant from a point source into navigable waters unless a permit is obtained under its provisions. The CWA mandates permits for wastewater and stormwater discharges and requires states to establish site-specific water quality standards for navigable bodies of water. The CWA also recognizes the need for planning to address nonpoint sources of pollution.

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act (42 USC § 7701 et seq.) was enacted in 1977 to "reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program." (NEHRP 2016). To accomplish this, the act established the National Earthquake Hazard Reduction Program (NEHRP), which refined the description of agency responsibilities, program goals, and objectives. NEHRP's mission includes improved understanding, characterization, and prediction of seismic hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improvement of mitigation capacity; and accelerated application of research results. NEHRP designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities.

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Programs under NEHRP help inform and guide planning and building code requirements such as emergency evacuation responsibilities and seismic code standards.

State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code § 2621 et seq.) was passed in 1972 to mitigate the hazard of surface faulting to structures used for human occupancy. The main purpose of the act is to prevent the construction of buildings used for human occupancy on top of the traces of active faults. Although the act addresses the hazards associated with surface-fault rupture, it does not address other earthquake-related hazards, such as seismically-induced ground shaking, liquefaction, or landslides.

The law requires the state geologist to establish regulatory zones (known as Earthquake Fault Zones or Alquist-Priolo Zones)—averaging about 0.25 mile wide—around the surface traces of active faults, and to publish appropriate maps that depict these zones. The maps are then distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. In general, construction within an Alquist-Priolo Zone requires a fault investigation be approved by the County prior to issuing grading and building permits. The Act seeks to prevent construction or major rehabilitation of structures used for human occupancy within 50 feet of an active fault.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (California Public Resources Code § 2690-2699.6 et seq.) was passed in 1990 to mitigate earthquake hazards other than surface-fault rupture, including seismically-induced ground shaking, liquefaction and landsliding. Under this act, seismic hazard zones have been mapped by the State Geologist to assist local governments in land use planning. The act states that "it is necessary to identify and map seismic hazard zones in order for cities and counties to adequately prepare the safety element of their general plans and to encourage land-use management policies and regulations to reduce and mitigate those hazards to protect public health and safety." (CGS 2008). Section 2697(a) of the Act states that "cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard."

California Building Code

The California Building Standards Code, also known as Title 24 of the California Code of Regulations, reflects various building standards that have been derived from different sources. One of these sources is the International Building Code, a model building code adopted across the United States that has been modified to suit conditions in the State, thereby creating what is known as the California Building Code (CBC), or Part 2 of CCR Title 24.

The CBC is updated every three years; the 2016 CBC took effect January 1, 2017. Much of the CBC is adopted by reference in the County Code, Title 6, Division 3, Chapter 1, as of January 1, 2018. Through the CBC, the State provides a minimum standard for building design and construction. The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition. It also regulates grading activities, including drainage and erosion control.

California Residential Code

The California Residential Code (CRC), Part 2.5 of CCR Title 24, also includes building standards that have been adopted from different sources, one of which is the International Building Code. The CRC was specifically developed for design and construction of detached one- and two-family dwellings and townhouses not more than three stories above grade and its accessory structures.

Requirements for Geotechnical Investigations

Requirements for geotechnical investigations are included in CBC Appendix J, Grading, Section J104; additional requirements for subdivisions requiring tentative and final maps and for other specified types of structures are in the California Health and Safety Code Sections 17953 to 17955 and in CBC Section 1803. Testing of samples from subsurface investigations is required, such as from borings or test pits. Studies must be done as needed to evaluate site geology, slope stability, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on load-bearing capacity, compressibility, liquefaction, differential settlement, and expansiveness. CBC Section J105 sets forth requirements for inspection and observation during and after grading.

Natural Hazards Disclosure Act

The Natural Hazards Disclosure Act (California Civil Code § 1103 et seq.), which became effective June 1,1998, requires sellers (and their real estate agents) to disclose to prospective buyers that real estate property being sold is in an earthquake fault zone, seismic hazard zone, flood hazard zone, dam inundation area, and special fire hazard areas. 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" 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.

Storm Water Pollution Prevention Plans

Pursuant to the CWA, in 2012, the State Water Resources Control Board issued a statewide general National Pollutant Discharge Elimination System (NPDES) Permit for stormwater discharges from construction sites (NPDES No. CAS000002). Under this Statewide General Construction Activity permit, discharges of stormwater from construction sites with a disturbed area of one or more acres are required to either obtain individual NPDES permits for stormwater discharges or be covered by the General Permit. Coverage by the General Permit is accomplished by completing and filing a Notice of Intent with the State Water Resources Control Board and developing and implementing a Storm Water Pollution Prevention Plan (SWPPP). Each applicant under the General Construction Activity Permit must ensure that a SWPPP is prepared prior to grading and is implemented during construction. The SWPPP must list best management practices (BMPs) implemented on the construction site to protect stormwater runoff and must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a monitoring plan if the site discharges directly to a water body listed on the state's 303(d) list of impaired waters.

Local

San Bernardino County 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 CBC within 180 days of publication. The County has adopted the most recent 2016 update of the CBC. The 2019 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. The California Building Standards 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.

In addition to the Alquist-Priolo Earthquake Fault Zones designated by the State, the County has designated County Fault Hazard Zones for particular faults not addressed by the State. The County Fault Hazard Zones also average about a quarter mile in width around the surface traces of County-recognized active faults. In general, construction within a County Fault Hazard Zone requires a fault investigation prior to issuing grading and building permits. Title 8 of the County Code, Chapter 82.15.040 (a) seeks to prevent construction or major rehabilitation of structures used for human occupancy within 50 feet of an active fault. Chapter 82.15.040 (b) of the Code requires that structures used for critical facilities be located at least 150 feet from any active fault trace.

Soil Percolation Tests for Septic Tank Construction

Soil percolation tests are required before construction of septic tanks in the unincorporated County under County Code Section 33.0894. Registrations or certifications required for persons performing such tests are specified in Section 33.0895.

5.6.1.2 EXISTING CONDITIONS

Geologic Setting

The following descriptions are mostly summarized from the Safety Background Report included as Appendix G1 to this Draft PEIR. The Paleontological Resources Technical Report, included as Appendix F to this Draft PEIR, contains an extensive description of geologic units in the County.

Valley Region

The Valley Region sits at the base of the San Bernardino and San Gabriel Mountains and 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). Most of the Valley Region is in the Upper Santa Ana River Valley. There are several small ranges of hills in the region, including the Crafton Hills near the City of Yucaipa and the Shandin Hills in the City of San Bernardino. The southwest edge of the County is in the Chino Hills and the southern edge of the County is in the Jurupa Hills in the City of Fontana and the Loma Linda Hills in the Cities of Grand Terrace, Colton, Loma Linda, and Redlands. Most of the Valley Region has a southerly slope; elevations are also somewhat higher in the east end of the region—for instance, Yucaipa City Hall in the east end of the region is at 2,618 feet amsl, and Chino City Hall in the west end of the region is at 728 feet 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.

Notable geological features in the Valley Region include the San Andreas Fault at the southwest foot of the San Bernardino Mountains, the San Jacinto Fault at the southwest edge of the San Bernardino Basin, and the Cucamonga Fault at the southern foot of the San Gabriel Mountains.

Mountain Region

The Mountain Region encompasses the San Bernardino Mountains and eastern San Gabriel Mountains. It 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. The highest peaks are Mount San Gorgonio, Mount San Antonio (Old Baldy), and Mount San Bernardino topping out between 10,000 and 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 to Paleozoic metamorphic rocks, which are typically overlain by thin ribbons of alluvium in the canyon bottoms.[1] Alluvial valleys (including Bear Valley and Swarthout Canyon) are in the Mountain Region. The San Andreas, San Jacinto, North Frontal, Cleghorn, and

[1] The Precambrian Eon extends from about 4.6 billion years to 542 million years, the Paleozoic Era extends from 542 to 251 million years, and Mesozoic Era extends from about 251 to about 65.5 million years before present. See USGS 2010.

Cucamonga faults are prominent faults that cross or are located near the Mountain Region. The San Andreas Fault extends along the southwest base of the San Bernardino Mountains and the northeast base of the San Gabriel Mountains. The San Andreas Fault within the County consists of multiple strands: the northern branch of the fault consist of Mission Creek and Mill Creek Faults and the southern branch of the fault consists of the San Bernardino Strand. The southern branch of the fault crosses the south County boundary just east of the City of Yucaipa. As the fault strands progress northwestward, the Mission Creek Fault ends in Mill Creek Canyon north of Yucaipa, and the Mill Creek Fault merges into the southern branch of the San Andreas Fault in the northwest part of the City of San Bernardino. The San Andreas Fault then continues northwestward as one fault zone, exiting the County just northwest of Wrightwood (CGS 2016; Lynch 2009). The Transverse Ranges Geomorphic Province is one of the most rapidly uplifting areas on Earth (Harden 2004).

Other notable geological features in the Mountain Region include the Mill, San Antonio, Lytle, and Cajon Canyons, Big Bear Valley, and Mormon Rocks, prominent sandstone outcrops southwest of Cajon Pass.

Desert Regions

The Desert Regions comprise most of the Mojave Desert and part of the Basin and Range geomorphic provinces of California. The Desert Regions generally lie between 2,000 and 5,000 feet amsl and are 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.[2] 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. The northernmost part of the Desert Regions is in the Basin and Range Province, which is characterized by mostly north-south-trending mountain ranges and valleys. Prominent active faults in the region include the San Andreas, Garlock, Landers-Kickapoo, Camp Rock-Emerson, Copper Mountain, Calico-Hidalgo, Helendale, Lenwood, Lockhart, Mesquite Lake, Pisgah-Bullion, Lavic Lake, Manix, North Frontal, Sky High Ranch, Old Woman Springs, Silver Reef, Johnson Valley, Ludlow, Cady, Cave Mountain, Red Pass, Blackwater, Mirage Valley, Kramer Hills, Mount General, Paradise, and Pinto Mountain Faults.

Notable geologic features in the North Desert Region include:

- Trona Pinnacles, a National Natural Landmark: vertical spires of calcium carbonate (“tufa”) up to 140 feet high, located east of Ridgecrest and State Route 178. (BLM 2017)
- Mitchell Caverns in Providence Mountains State Recreation Area (a state park in the Mojave National Preserve). (CDPR 2017)
- Rainbow Basin, a National Natural Landmark: multicolored rock formations and a rich fossil locality, located north of Barstow. (NPS 2017a)

[2] The Cenozoic Era extends from about 65.5 million years ago to the present. “Precambrian” informally refers to any time division before about 542 million years ago. See USGS 2010.

- Amboy Crater, a National Natural Landmark: a volcano west of Amboy. (NPS 2017b)
- Pisgah Crater: a volcano, part of the Lavic Lake Volcanic Area, east of Newberry Springs. (Sylvester and Gans 2016)
- Afton Canyon: the canyon walls are multicolored volcanic rocks. (Sylvester and Gans 2016)
- Cinder Cone Natural Area, a National Natural Landmark in Mojave National Preserve: over 20 large cinder cones—a type of volcano—of recent origin, located north of Kelso. (NPS 2017c)
- Turtle Mountains Natural Area, a National Natural Landmark: includes volcanic peaks, spires, and cliffs, located south of Needles. (BLM 2017b)
- Kelso Dunes, a National Natural Landmark in Mojave National Preserve: sand dunes up to 600 feet high, located southwest of Kelso. (NPS 2012)
- Blackhawk Landslide: 700 million tons of rock fell from Blackhawk Mountain in the San Bernardino Mountains, extending 5.6 miles into the Mojave Desert, over 17,400 years ago. (Sylvester and Gans 2016)

East Desert Region

The East Desert Region consists partly of the northeastern end of the Transverse Ranges Geomorphic Province, and partly of the Mojave Desert Geomorphic Province. The Morongo Basin is a long northeast-southwest-trending desert valley encompassing most of the southwest quadrant of the East Desert Region, including the towns of Twentynine Palms and Yucca Valley. Notable geologic features include the Wonderland of Rocks, a 12-square-mile area of eroded, fractured granite boulders in Joshua Tree National Park, Big Morongo Canyon Preserve (a 48-square-mile area where the Morongo Valley Fault forces groundwater to the surface), and Bristol, Cadiz, Danby, and Dale Dry Lakes.

Seismic Hazards

Surface Rupture of a Fault

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 hypocenters less than 12 miles deep. Primary ground rupture usually results in a relatively small portion 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.

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

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- 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.
- 1975 Galway Lake Earthquake. Caused minor surface ruptures.
- 1947 Manix Earthquake. Caused minor surface ruptures.
- 1857 Fort Tejon Earthquake. Surface ruptures extended for 220 miles, from the Cajon Pass to Cholame in west-central California; displacements averaged 15 feet with a maximum of 30 feet.
- 1812 Wrightwood Earthquake (previously known as the San Juan Capistrano Earthquake). Surface ruptures extended for about 35 miles, from near Pearblossom to North San Bernardino.
- 1690 Earthquake along the San Andreas Fault through Wrightwood. Significant surface ruptures extended for approximately 150 miles from near San Bernardino to the Salton Sea.
- 1610 Earthquake along the San Andreas Fault through Wrightwood. Significant surface ruptures.

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 rupture and ground deformation would be expected. Alquist-Priolo Earthquake Fault Zones, County Fault Hazard Zones, and faults capable of generating earthquakes over magnitude 5.0 are mapped on Figure 5.6-1, *Alquist-Priolo Fault Zones and County Fault Hazard Zones*.

Ground Shaking

Ground shaking, that is, ground displacement due to seismic waves from an earthquake, is responsible for the vast majority of earthquake 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 California Geological Survey produced shake maps that illustrate where the intensity of ground shaking from earthquakes is expected to be most pronounced (see Figure 5.6-2, *Earthquake Shaking Potential*).

Figure 5.6-1 Alquist-Priolo Fault Zones and County Fault Hazard Zones

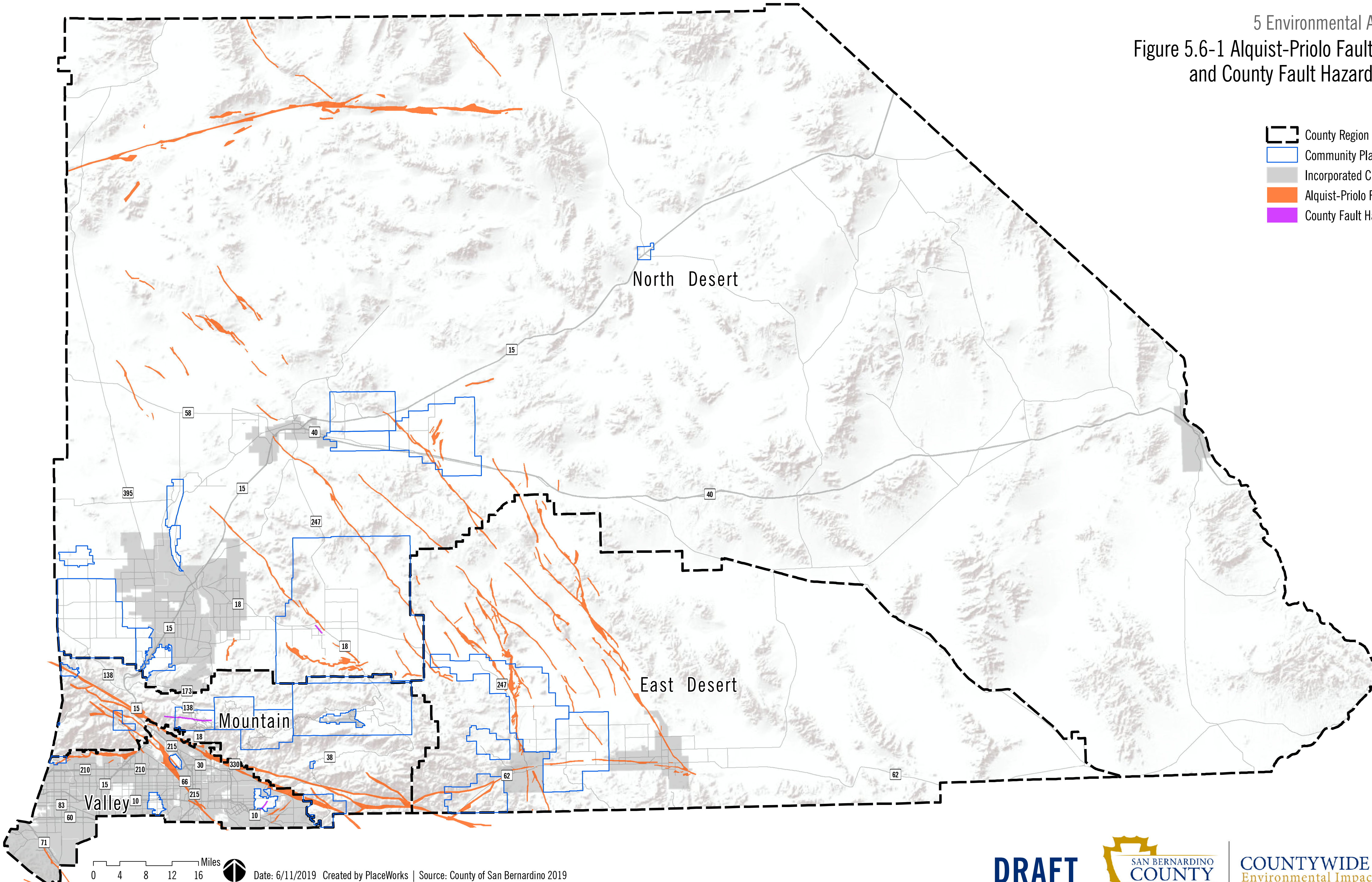

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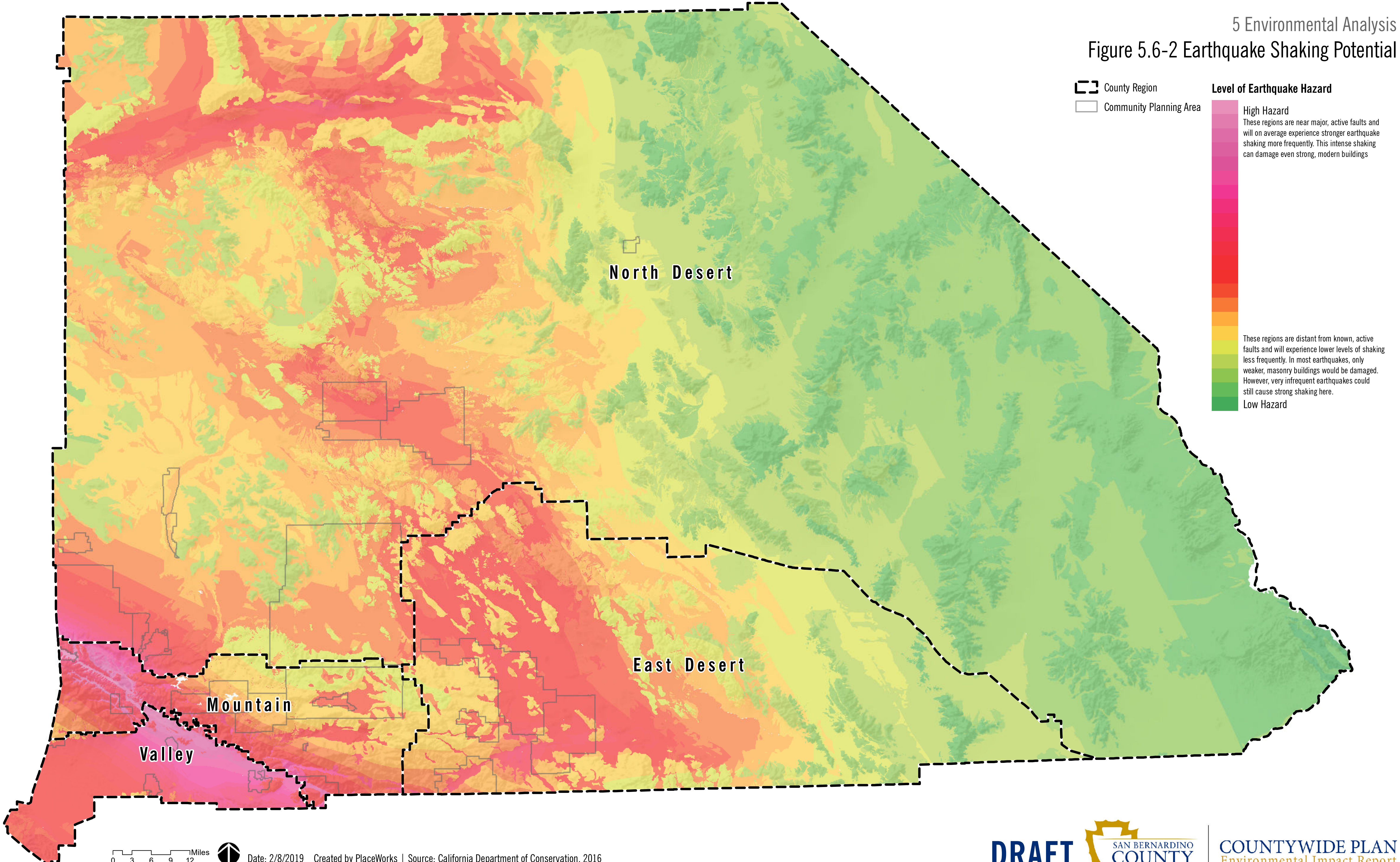
Figure 5.6-2 Earthquake Shaking Potential



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The energy released by an earthquake is measured as moment magnitude. The moment magnitude scale is logarithmic; therefore, each one-point increase in magnitude represents a tenfold increase in amplitude of the waves, as measured at a specific location, and a 32-fold increase in energy. Therefore, a magnitude 7 earthquake produces 100 times the ground motion amplitude of a magnitude 5 earthquake and 900 times as much energy release, while a magnitude 8 earthquake (expected from a rupture along the San Andreas Fault) produces 1000 times the ground motion amplitude of a magnitude 5 earthquake and about 2,700 times as much energy release.

The Valley Region has the highest probability of strong ground shaking, specifically in San Bernardino, Devore, Fontana, Colton, Rialto, Loma Linda, Highland, Muscoy, and Redlands. Other likely places for strong 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, Lake Arrowhead, and Crestline. In the desert regions, likely places for moderate to strong ground shaking include Baldy Mesa, Hesperia-Phelan, Victorville, Adelanto, Death Valley, Panamint Valley, Morongo Valley-Yucca Valley, Twentynine Palms, Joshua Tree, High Desert, Landers, Lucerne Valley, Apple Valley, Barstow-Lenwood, and Yermo-Newberry Springs.

Ground shaking potential in San Bernardino County is shown on Figure 5.6-2, *Earthquake Shaking Potential*.

Historical Earthquakes

Earthquakes in the last 100 years in San Bernardino County with magnitudes of 6.0 or greater are listed in Table 5.6-1, *Historic Earthquakes in and near San Bernardino County*. Additional notable earthquakes include the 1812 Wrightwood Earthquake on the San Andreas Fault, with an estimated magnitude of 7.5 and the 1857 Fort Tejon Earthquake, also along the San Andreas Fault, with an estimated earthquake of magnitude 7.9. The chapel at Mission San Juan Capistrano in Orange County collapsed during the 1812 earthquake, killing 40. The Fort Tejon earthquake caused the collapse of an adobe house killing one person .Other earthquakes originating in the county include the 1858 San Bernardino earthquake, the 1894 Lytle Creek earthquake, the 1899 Lytle Creek-Cajon Pass earthquake, the 1907 San Bernardino earthquake, the 1970 Lytle Creek-Cajon Pass earthquake, the 1979 Homestead Valley earthquake, the 1988 Upland earthquake, the 1990 Upland earthquake, and the 2008 Chino Hills earthquake (SCEDC 2017; Jordan 2019).

Table 5.6-1 Selected Historic Earthquakes in and near San Bernardino County

Earthquake	Magnitude	Fault(s)	Notable Effects
Landers 1992	7.3	Burnt Mountain, Camp Rock-Emerson-Copper Mountain; Eureka Peak, Johnson Valley	3 fatalities, 400+ injuries; relatively little damage
Big Bear Lake 1992	6.4	? (no surface trace of a fault identified)	Substantial damage in Big Bear area
Hector Mine 1999	7.1	Lavic Lake	Very little damage
Manix 1947	6.5	Manix	Relatively little damage
Loma Linda 1923	6.3	San Jacinto	2 injuries; damage mostly minor

Sources: PlaceWorks 2016; SCEDC 2017.

Hazardous Buildings

The principal threat in an earthquake is the damage it causes to buildings that house people or an essential function. Over the past decade, advances in engineering design and building code standards have greatly reduced the potential for most new buildings to collapse during an earthquake. However, several specific types of older building are particularly subject to collapse.

- **Unreinforced Masonry.** In the late 1800s and early 1900s, unreinforced masonry was the most common type of construction for large downtown commercial structures and multistory apartments and hotels. These buildings were a collapse hazard in the 1906 San Francisco earthquake, the 1925 Santa Barbara earthquake, and the aftermath of the 1933 Long Beach earthquake. They are the most hazardous buildings in an earthquake.

  In 1986, California passed the Unreinforced Masonry Building Law (SB 547), which requires local jurisdictions to inventory pre-1943 unreinforced masonry buildings and develop mitigation programs to correct structural hazards.

- **Precast Concrete Tilt-up.** Introduced after World War II, this building type was popular for light industrial buildings during the late 1950s and 1960s. The 1971 San Fernando earthquake caused extensive damage to concrete tilt-up buildings—the concrete wall panels fell outward and the roofs collapsed. Walls needed to be more firmly anchored to the roof, floor, and foundation, and the roof diaphragm needed to be much stronger.[3]

- **Soft-Story.** Soft-story buildings have at least one floor (commonly the ground floor) with significantly less rigidity and/or strength than the rest. It needs special design features to give the building adequate structural integrity. Typical examples of soft-story construction are buildings with glass curtain walls on the first floor only, and buildings on stilts or columns that leave the first story open for landscaping, building entry, parking, etc. From the early 1950s to the early 1970s, soft-story buildings were popular for low- and midrise concrete-frame structures.

- **Nonductile Concrete Frame.** Nonductile concrete frame buildings have stiff reinforced concrete frames that do not bend when shaken or twisted, which increases the likelihood of structural failure during an earthquake. This type of construction was common in the early days of reinforced concrete buildings and continued to be built until 1973, when the codes were changed to require ductility.

  Thousands of these buildings were constructed for commercial and light industrial use in California's older, densely populated cities. Many have four to eight stories, although many are also in the lower height range. This category includes one-story parking garages with heavy concrete roof systems supported by nonductile concrete columns.

3 A roof diaphragm is a structural roof deck that is capable of resisting shear that is produced by lateral forces, such as wind or seismic loads.

Liquefaction

Liquefaction refers to loose, saturated sand or silt deposits that behave as a liquid and lose their load-supporting capability when strongly shaken. 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 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 groundwater is near the ground surface. Liquefaction susceptibility in San Bernardino County is shown on Figure 5.6-3, *Liquefaction and Landslide Susceptibility*.

Valley Region

Portions of the Valley consist 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 events and/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, Mill Creek, City Creek, Cajon Creek, and Lytle Creek. Southern Chino and much of southern San Bernardino are also susceptible to liquefaction, and Ontario's New Model Colony (the Ranch area) has also been found to be 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 some smaller areas near water bodies such as Big Bear Lake, Erwin Lake, and Baldwin Lake.

Desert Regions

In the Desert Regions, 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. Liquefaction potential is high along the Mojave River (eastern Victorville, west Apple Valley, Hesperia, and Oro Grande to Barstow). 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, the Helendale Fault near Helendale, and the Lenwood and Lockhart Faults near Harper Lake. Areas along the Colorado River also pose a high liquefaction potential.

Landslides and Slope Instability

Landslides typically occur on hillsides or in steep terrain. They are influenced by the nature of the rock or soil type, slope angle, groundwater levels, rainfall, and large earthquakes. Landslides can also be affected by construction activity, unusual natural or artificial wetting, and erosion. 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. Landslide susceptibility is shown on Figure 5.6-3, *Liquefaction and Landslide Susceptibility*. Mudflows and debris flows are discussed in Section 5.9.1.

Valley Region

In the Valley Region, landslides are of concern in areas of moderate relief, such as in the Chino Hills, Shandin Hills, Verdemont Hills, Loma Linda Hills, Jurupa Hills, and Crafton 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, Loma Linda, Redlands, Colton, 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 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 17,400-year-old Blackhawk Landslide originated in the Mountain Region (see *Geologic Setting, North Desert Region*, above).

Geologic Hazards

Expansive and Collapsible Soils

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 soil volume 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 as it dries and swells as it becomes wet. Collapsible soils consist of loose, dry, low-density materials that are weakly cemented and that thus can collapse or be compressed with the addition of water or weight. Collapsible soils include young fine-grained alluvial materials, wind-deposited soils, and soils with salts.

Valley Region

The Valley Region is unlikely to have expansive soils except for two areas: one in Grand Terrace and the other in the Chino Hills area south of Chino Hills State Park. 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.

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.

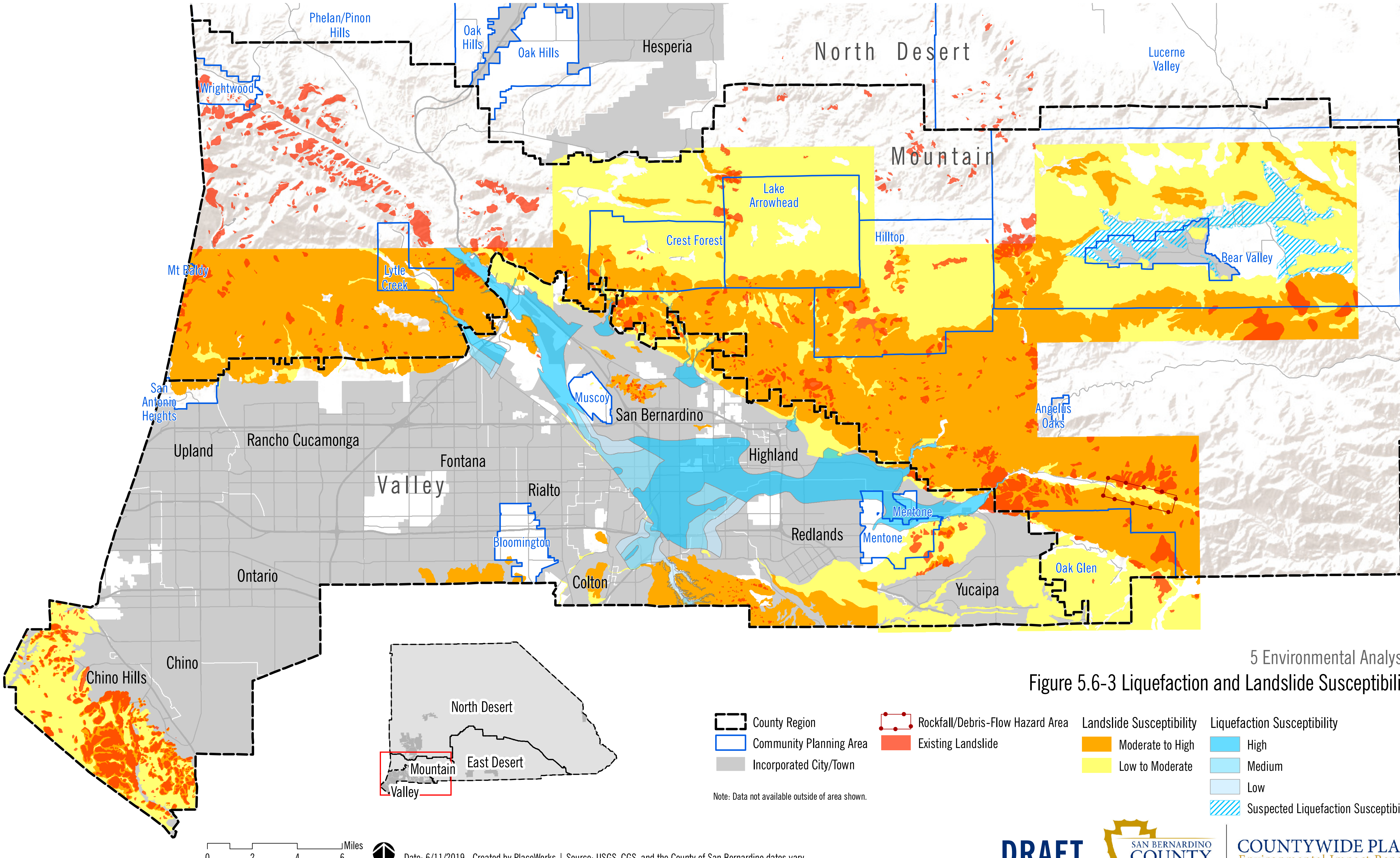

Figure 5.6-3 Liquefaction and Landslide Susceptibility

County Region
Community Planning Area
Incorporated City/Town
Rockfall/Debris-Flow Hazard Area
Existing Landslide

Landslide Susceptibility
Moderate to High
Low to Moderate

Liquefaction Susceptibility
High
Medium
Low
Suspected Liquefaction Susceptibility

Note: Data not available outside of area shown.

Date: 6/11/2019 Created by PlaceWorks | Source: USGS, CGS, and the County of San Bernardino dates vary

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Desert Regions

Much of the Desert Regions has low to moderately expansive soils. In select areas, such as Lucerne Valley and dry lakebeds, the soils can be highly expansive. The Desert Regions have the highest potential for collapsible soils due to their aridity, the prevalence of both alluvial and wind-deposited soils, and soils with salts.

Ground Subsidence

Subsidence effects include the formation of ground fissures, ground cracking, and uneven settlement that could damage building foundations, pipelines, and other infrastructure. Subsidence in San Bernardino County is primarily the result of groundwater extraction, prolonged drought, and geologic conditions. Ground subsidence potential in San Bernardino County is shown on Figure 5.6-4, *Land Subsidence Potential*.

Valley Region

Subsidence from groundwater withdrawal has occurred in the portions of the Valley Region over the La Verne, Chino-Riverside, Bunker Hill, and Yucaipa sub-basins of the Upper Santa Ana Valley Groundwater Basin. Subsidence up to six feet is possible in these areas. Specific occurrences of subsidence include up to four 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, which is not subject to movement like fine-grained sediments. However, the California Geological Survey 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 Regions

Subsidence due to groundwater extraction affects the Desert Regions, particularly near dry lakebeds in the Mojave and Morongo basins. The US Geological Survey has identified five areas with measurable amounts of subsidence to date, including El Mirage Lake, Harper Lake, Coyote Lake, Lucerne Lake, and Troy Lake/Newberry Springs (USGS 2019). 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 Mojave River, Irwin Subbasin, Fremont Valley, and Twentynine Palms.

Corrosive Soils

Corrosive soils contain chemicals that can react with construction materials (e.g., concrete, steel, and iron) 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 (low pH) soil. 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.

Desert Regions

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 Ground Combat Center Twentynine Palms. Certain dry lakebeds (e.g., Searles Lake, Mesquite Lake, Bristol Lake, Cadiz Lake, Danby Lake, and Dale Lake) produce commercially valuable, though corrosive, minerals.

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.

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, and 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 parts of the Chino Valley.

5.6.2 Thresholds of Significance

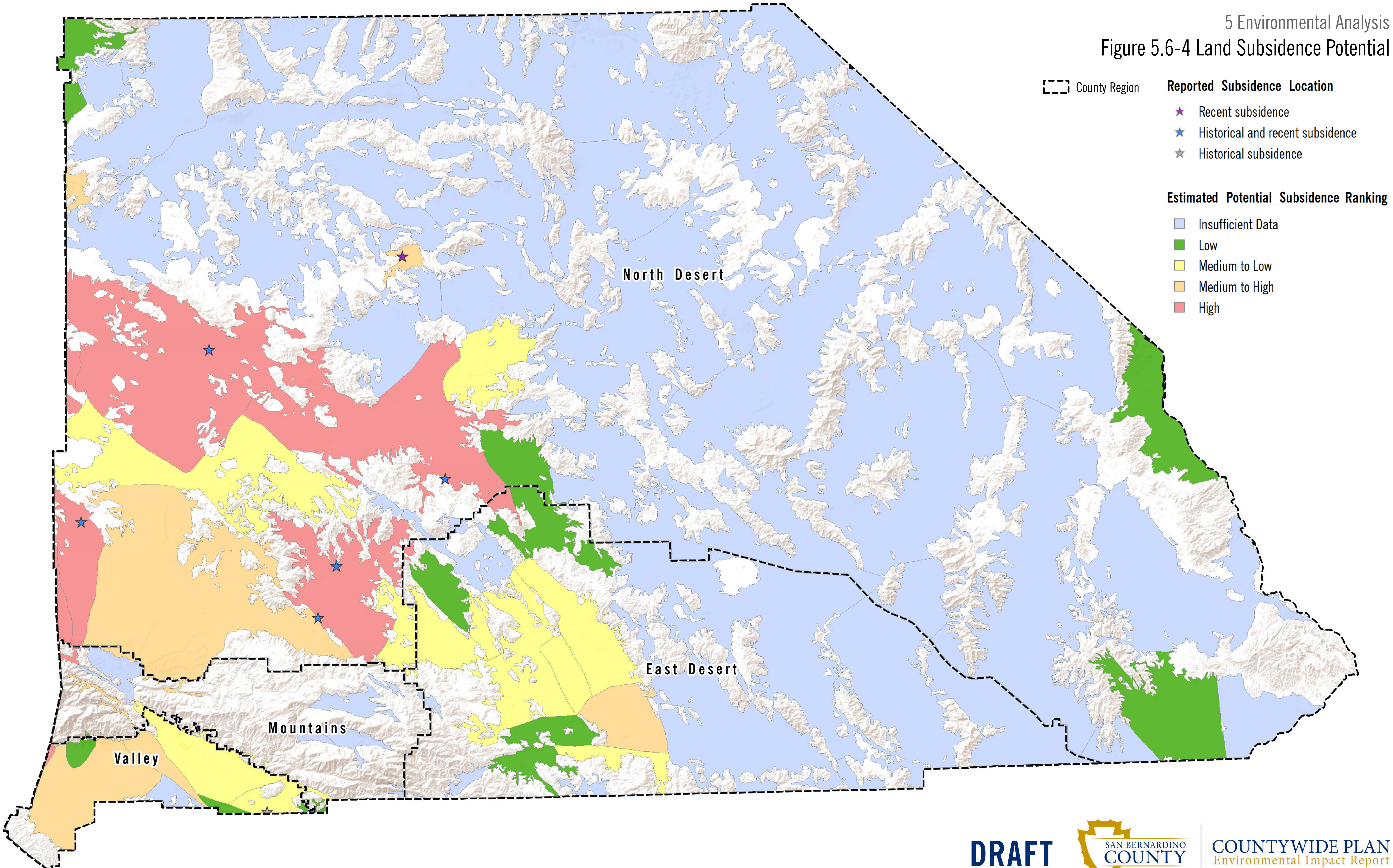
According to Appendix G of the CEQA Guidelines, a project would normally have a significant effect on the environment if the project would:

G-1 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42.)
- ii) Strong seismic ground shaking.
- iii) Seismic-related ground failure, including liquefaction.
- iv) Landslides.

G-2 Result in substantial soil erosion or the loss of topsoil.

Figure 5.6-4 Land Subsidence Potential



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COUNTYWIDE PLAN
Environmental Impact Report

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G-3 Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

G-4 Be located on expansive soil, as defined in Table 18-1B of the Uniform Building Code (1994), creating substantial risks to life or property.

G-5 Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

Pursuant to a 2015 California Supreme Court decision (*California Building Industry Association vs. Bay Area Air Quality Management District*, 62 Cal.4th 369), impacts of the environment on a project are now excluded from CEQA with certain exceptions. One exception is where development of a project would exacerbate an existing hazard. Two examples of this are: 1) where ground disturbance by a project could expose people and/or the environment to existing soil contamination and 2) a project contributing to the potential for soil collapse by wetting soil (such as by irrigation) and/or placing a load (such as a building) on soil. However, a project attracting increased numbers of people to a place affected by an existing hazard, for instance by building structures on an active fault, is no longer an impact within the purview of CEQA.

5.6.3 Regulatory Requirements and General Plan Policies

5.6.3.1 REGULATORY REQUIREMENTS

RR GEO-1 **San Bernardino County Code: Building Code.** The Project will be designed and constructed in accordance with the San Bernardino County Code, which adopts the California Building Code (CBC) and California Residential Code (CRC), which are based on the International Building Code (IBC). New construction, alteration, or rehabilitation shall comply with applicable ordinances set forth by the County and/or by the most recent County building and seismic codes in effect at the time of Project design. In accordance with Section 1803.2 of the 2016 CBC, and County Code Title 8, Chapter 87.08, a geotechnical investigation is required that must evaluate soil classification, site geology, slope stability, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on soil-bearing capacity, compressibility, liquefaction, and expansiveness, as necessary, determined by the County Building Official. The geotechnical investigation must be prepared by registered professionals (i.e., California Professional Civil Engineer and as necessary a Professional Engineering Geologist). Recommendations of the report, as they pertain to structural design and construction recommendations for earthwork, grading, slopes, foundations, pavements, and other necessary geologic and seismic considerations, must be incorporated into the design and construction of the Project.

RR GEO-2 **San Bernardino County Code: Septic Tanks.** Soil percolation tests are required before construction of septic tanks in unincorporated San Bernardino County under County Code Section 33.0894. Registrations or certifications required for persons performing such tests are specified in Section 33.0895.

5. Environmental Analysis
GEOLOGY AND SOILS

RR HYD-1 **Pollutant Discharge Elimination System (NPDES).** The Project will be constructed in accordance with the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with the Construction and Land Disturbance Activities, Order No 2009- 0009-DWQ (as amended by 2010-0014-DWQ and 2012-0006-DWQ), NPDES No. CAS000002 (or the latest approved Construction General Permit). Compliance requires filing a Notice of Intent (NOI); a Risk Assessment; a Site Map; a Storm Water Pollution Prevention Plan (SWPPP) and associated Best Management Practices (BMPs); an annual fee; and a signed certification statement.

5.6.3.2 POLICY PLAN

The Hazards Element of the proposed San Bernardino Countywide Plan sets forth the following policies intended to avoid or minimize exposure to geologic hazards and minimize harm from such hazards.

Goal HZ-1 **Natural Environmental Hazards.** Minimized risk of injury, loss of life, property damage, and economic and social disruption caused by natural environmental hazards and adaptation to potential changes in climate.

Policy HZ-1.1 **New subdivisions in environmental hazard areas.** We require all lots and parcels created through new subdivisions to have sufficient buildable area outside of the following environmental hazard areas:

- Flood: 100-year flood zone, dam/basin inundation area
- Geologic: Alquist Priolo Earthquake Fault Zone; County-identified fault zone; rockfall/debris-flow hazard area, existing and County-identified landslide area

Policy HZ-1.2 **New development in environmental hazard areas.** We require all new development to be located outside of the environmental hazard areas listed below. For any lot or parcel that does not have sufficient buildable area outside of such hazard areas, we require adequate mitigation, including designs that allow occupants to shelter in place and to have sufficient time to evacuate during times of extreme weather and natural disasters.

- Flood: 100-year flood zone, dam/basin inundation area
- Geologic: Alquist Priolo Earthquake Fault Zone; County-identified fault zone; rockfall/debris-flow hazard area, medium or high liquefaction area (low to high and localized), existing and County-identified landslide area, moderate to high landslide susceptibility area,
- Fire: high or very high fire hazard severity zone

Policy HZ-1.5 **Existing properties in environmental hazard areas.** We encourage owners of existing properties in hazard areas to add design features that allow occupants to shelter in place and to have sufficient time to evacuate during times of extreme weather and natural disasters.

Policy HZ-1.6 **Critical and essential facility location.** We require new critical and essential facilities to be located outside of hazard areas, whenever feasible.

Policy HZ-1.7 **Underground utilities.** We require that underground utilities be designed to withstand seismic forces, accommodate ground settlement, and hardened to fire risk.

Policy HZ-1.8 **Wind erosion hazards.** We require new development in medium-high or high wind erosion hazard areas to minimize the effects of wind-blown soil through building and site design features such as fencing, surface treatment or pavement, attenuation or wind barriers, architectural features, building materials, and drought resistant landscaping.

Policy HZ-1.9 **Hazard areas maintained as open space.** We minimize risk associated with flood, geologic, and fire hazard zones or areas by encouraging such areas to be preserved and maintained as open space.

Policy HZ-1.10 **Energy independence.** We encourage new residential development to include rooftop solar energy systems and battery storage systems that can provide backup electrical service during temporary power outages.

The Natural Resources Element of the proposed Countywide Plan contains the following policies intended in part to minimize soil erosion:

Goal NR-2 **Water Quality.** Clean and safe water for human consumption and the natural environment.

Policy NR-2.5 **Stormwater discharge**. We ensure compliance with the County's Municipal Stormwater NPDES (National Pollutant Discharge Elimination System) Permit by requiring new development and significant redevelopment to protect the quality of water and drainage systems through site design, source controls, stormwater treatment, runoff reduction measures, best management practices, low impact development strategies, and technological advances. For existing development, we monitor businesses and coordinate with municipalities.

Goal NR-7 **Agriculture and Soils.** An ability of property and farm owners to conduct sustainable and economically viable farm operations.

Policy NR-7.1 **Protection of agricultural land.** We protect economically viable and productive agricultural lands from the adverse effects of urban encroachment, particularly increased erosion and sedimentation, trespass, and non-agricultural land development.

5.6.4 Environmental Impacts

The applicable thresholds are identified in brackets after each impact statement.

Most population growth due to buildout of the Countywide Plan would be in two areas: the Bloomington Community Plan Area (CPA) in the Valley Region, and future master planned communities in the Town of Apple Valley sphere of influence (SOI) in the North Desert Region. Employment growth would be focused in the unincorporated portions of the Valley region, particularly in the Fontana SOI, East Valley Area Plan, and Bloomington CPA (see Section 5.0 for further discussion). Thus, impacts are analyzed in some detail for the four areas where most growth would occur, and much more generally for the rest of the unincorporated areas of the County.

Impact 5.6-1: Project residents, workers, and visitors would be subject to potential seismic-related hazards. [Thresholds G-1.i through G-1.iii]

Surface Rupture of a Fault

There are numerous active faults in the County, in the Valley and Mountain regions and the west half of the Desert Regions. Some projects may be proposed within Alquist-Priolo Earthquake Fault Zones. Such projects would be required to have fault studies done to determine whether traces of active faults pass through or near those project sites; where such traces were found, buildings for human occupancy must generally be set back at least 50 feet from such traces. The County Development Code requires all critical and essential facilities to be located a minimum of 150 feet away from active and potentially active faulting.

The nearest known active faults to the four areas where most growth under the Countywide Plan would occur are identified below:

Valley Region

- **Bloomington CPA:** No active faults mapped on Figure 5.6-1 pass through Bloomington; the nearest such fault is the San Jacinto Fault Zone about 3.8 miles to the northeast.
- **City of Fontana SOI (west):** The Fontana Fault is coincident with the southeast boundary of the SOI. Additionally, the Red Hill-Etiwanda Avenue Fault is approximately three miles to the northwest.
- **East Valley Area Plan area:** No active faults pass through the East Valley Area Plan area; the nearest such faults are the San Jacinto and San Andreas Fault Zones about 4 miles to the southwest and northeast, respectively. The Reservoir Canyon Branch of the Crafton Hills Fault Zone, included within a County Fault Hazard Zone, is located approximately 4 miles southeast of the East Valley Area Plan

Desert Regions

- **Town of Apple Valley SOI:** The Helendale Fault and an Alquist-Priolo Earthquake Fault Zone centered on the fault pass through the eastern end of the Hacienda- Fairview Valley Specific Plan area, one of two areas of substantial growth identified within the SOI. Fault studies would be required for projects within the Alquist-Priolo Earthquake Fault Zone. The Helendale Fault is approximately two miles northeast of the other growth area (Planned Annexation Area).

Impacts would be less than significant after compliance with the Alquist-Priolo Earthquake Fault Zoning Act which requires a fault investigation for construction within 50 feet of an Alquist-Priolo Zone prior to issuing permits. The County Development Code further requires that all critical and essential facilities be located a minimum of 150 feet away from active and potentially active faulting.

Ground Shaking

All projects developed under the Countywide Plan would subject people and structures to hazards from ground shaking. Such hazards are generally most severe in the Valley and Mountain regions near the San Andreas and San Jacinto fault zones (see Figure 5.6-2). Geotechnical investigations would be required for each development or redevelopment project pursuant to the CBC or CRC and aforementioned California Health and Safety Code sections. Geotechnical investigations would calculate seismic design parameters, pursuant to CBC requirements, that must be used in the design of proposed buildings. Seismic hazard impacts of Countywide Plan buildout in the Valley Region would be less than significant after compliance with regulatory requirements for geotechnical investigations and seismic safety.

Liquefaction

Countywide Plan buildout would involve development of some projects in areas of liquefaction susceptibility mapped on Figure 5.6-3. Geotechnical investigations would be required for each project developed under the Countywide Plan. Such investigations would determine whether known active faults passed through or near those project sites, and thus whether fault studies were required under the Alquist-Priolo Earthquake Fault Zoning Act. Such investigations would also assess liquefaction potential on each site and recommend any measures required to minimize liquefaction hazards to people or structures in accordance with the Seismic Hazards Mapping Act. Impacts would be less than significant.

Conditions by Region

Valley Region

Portions of the east half of the Valley Region, especially in the floodplains of the Santa Ana River, Cajon Creek, and Lytle Creek, are susceptible to liquefaction. The East Valley Area Plan area is not in a liquefaction susceptibility area (see Figure 5.6-3). Most projects that would be developed under the Countywide Plan in the Valley Region would not subject people or structures to substantial hazards from liquefaction in a liquefaction hazard zone mapped on Figure 5.6-3.

Mountain Region

The only areas of liquefaction susceptibility in the Mountain Region mapped on Figure 5.6-3 are along Lytle Creek, Cajon Creek, and in several canyon bottoms on the southwest slopes of the San Bernardino Mountains. No growth would occur in the canyon bottoms, as they are subject to flooding; are very steep terrain; and are in the San Bernardino National Forest. Little growth is projected for the Lytle Creek CPA and areas near Cajon Creek. Thus, few if any projects would be proposed in areas of the Mountain Region susceptible to liquefaction.

Desert Regions

In the Desert Regions, 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. Liquefaction potential is high along the Mojave River (eastern Victorville, west Apple Valley, and Hesperia). The planned growth areas in the Town of Apple Valley SOI are at least 3.9 miles from the Mojave River and are not in areas mapped as susceptible to liquefaction on Figure 5.6-3.

Level of Significance before Mitigation: With implementation of RR GEO-1, Impact 5.6-1 would be less than significant.

Impact 5.6-2: Development of projects under the Countywide Plan could cause substantial soil erosion. [Threshold G-2]

Construction activities related to the buildout of the Countywide Plan would potentially result in soil erosion. Clearing, grading, excavation, and other construction activities may impact water quality due to sheet erosion of exposed soils and subsequent depositing of sediment in local drainages. Grading activities in particular lead to exposed areas of loose soil and sediment stockpiles that are susceptible to uncontrolled sheet flow. Although erosion occurs naturally in the environment, primarily from weathering by water and wind, improperly managed construction activities can substantially accelerate erosion, which is detrimental to the environment.

Construction General Permit

Construction projects under the Countywide Plan must provide evidence that the development of projects disturbing one acre or more of soil comply with the most current Statewide Construction General Permit and associated local NPDES regulations to ensure that the potential for soil erosion is minimized. In accordance with the updated Construction General Permit , the following permit registration documents are to be submitted to the State Water Resources Board prior to commencement of construction activities:

- Notice of Intent
- Risk Assessment (standard or site specific)
- Particle Size Analysis (if site-specific risk assessment is performed)
- Site Map
- Stormwater Pollution Prevention Plan (SWPPP)
- Active Treatment System Design Documentation (if determined necessary)
- Annual Fee and Certification

Best Management Practices

In accordance with the existing and updated Construction General Permit, a construction SWPPP must be prepared and implemented at all construction projects with one acre or greater of soil disturbance, and revised as necessary as administrative or physical conditions change. The SWPPP must be made available for review upon request. It must describe construction BMPs that address pollutant source reduction and provide measures/controls necessary to mitigate potential pollutant sources. These measures/controls include, but are not limited to, erosion controls, sediment controls, tracking controls, nonstormwater management, materials and waste management, and good housekeeping practices. The BMPs for construction activities are briefly discussed below and are summarized in Table 5.6-2.

Table 5.6-2 Construction BMPs

Category	Purpose	Examples
Erosion Controls	Consists of using project scheduling and planning to reduce soil or vegetation disturbance (particularly during the rainy season), preventing or reducing erosion potential by diverting or controlling drainage, as well as preparing and stabilizing disturbed soil areas.	Scheduling, preservation of existing vegetation, hydraulic mulch, hydroseeding, soil binders, straw mulch, geotextile and mats, wood mulching, earth dikes and drainage swales, velocity dissipation devices, slope drains, streambank stabilization, compost blankets, soil preparation/roughening, and non-vegetative stabilization
Sediment Controls	Filter out soil particles that have been eroded and transported in water.	Silt fence, sediment basin, sediment trap, check dam, fiber rolls, gravel bag berm, street sweeping and vacuuming, sandbag barrier, straw bale barrier, storm drain inlet protection, manufactured linear sediment controls, compost socks and berms, and biofilter bags
Wind Erosion Controls	Consists of applying water or other dust palliatives to prevent or minimize dust nuisance.	Dust control soil binders, chemical dust suppressants, covering stockpiles, permanent vegetation, mulching, watering, temporary gravel construction, synthetic covers, and minimization of disturbed area
Tracking Controls	Minimize the tracking of soil offsite by vehicles	Stabilized construction roadways and construction entrances/exits, and entrance/outlet tire wash.
Non-Storm Water Management Controls	Prohibit discharge of materials other than stormwater, such as discharges from the cleaning, maintenance, and fueling of vehicles and equipment. Conduct various construction operations, including paving, grinding, and concrete curing and finishing, in ways that minimize non-stormwater discharges and contamination of any such discharges.	Water conservation practices, temporary stream crossings, clear water diversions, placement of tire cleaning mats or trackout plates, temporary placement of coarse gravel at entrances/exits, reporting of illicit connection/discharge , potable and irrigation water management, and the proper management of the following operations: paving and grinding, dewatering, vehicle and equipment cleaning, fueling and maintenance, pile driving, concrete curing, concrete finishing, demolition adjacent to water, material over water, and temporary batch plants.
Waste Management and Controls (i.e., good housekeeping practices)	Management of materials and wastes to avoid contamination of stormwater.	Stockpile management, spill prevention and control, solid waste management, hazardous waste management, contaminated soil management, concrete waste management, sanitary/septic waste management, liquid waste management, and management of material delivery storage and use.

Source: CASQA 2012.

Prior to commencement of construction activities, the project-specific SWPPP(s) would be prepared in accordance with the site-specific sediment risk analyses based on the grading plans, with erosion and sediment controls proposed for each phase of construction for the individual project. The phases of construction would define the maximum amount of soil disturbed, the appropriate size for sediment basins, and other control measures to accommodate all active soil disturbance areas and the appropriate monitoring and sampling plans.

SWPPPs would require projects to plan BMPs for four general phases of construction: (1) grading and land development (e.g., mass grade & rough grade), (2) utility and road installation, (3) vertical construction, and (4) final stabilization and landscaping. Therefore, BMP implementation for new construction can be evaluated in this general context. Site-specific details on individual BMPs would be dependent on the scope and breadth of each future project, which are not known at this time.

Both state and local regulations would effectively mitigate construction stormwater runoff impacts from CWP buildout. The San Bernardino County Development Code Chapter 85.11.030 requires standard erosion control practices to be implemented for all construction. Additionally, construction sites are required to prepare and implement a SWPPP in accordance with the requirements of the statewide Construction General Permit and are subject to the oversight of the relevant Regional Water Quality Control Board. The SWPPP must include BMPs to reduce or eliminate erosion and sedimentation from soil-disturbing activities. Implementation of these state and local requirements would effectively protect projects from violating any water quality standards or waste discharge requirements from construction activities, and impacts would be less than significant.

Level of Significance before Mitigation: With implementation of RR HYD-1, Impact 5.6-2 would be less than significant.

Impact 5.6-3: Countywide Plan buildout could subject people or structures to landslide hazards. [Thresholds G-1.iv and G-3 (part)]

Some projects that would be developed under the Countywide Plan may be in areas susceptible to landslides. 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. In the Mountain Region, landslides of all types are common in the mountains due to steep slopes, sharp narrow ridges, and steep-walled canyons and valleys when combined with adverse geologic structure, high rainfall, and earthquakes. In the Desert Regions, mountain slopes may be susceptible to landslides; however, landslide susceptibility is not mapped for the Desert Regions on Figure 5.6-3.

Each project within hillside areas that have slope gradients of 15% to less than 40% would be required to conduct a geotechnical investigation of its site that would assess existing landslide susceptibility and impacts of proposed grading and construction on landslide hazard and provide any needed recommendations to minimize landslide hazards. Proposed development on larger landslides or within hillside areas that have slope gradients of 40% or greater may not prove feasible, based on the results of required geological and geotechnical investigations, and would not be allowed to proceed. Impacts would be less than significant after compliance with the CBC and other requirements for geotechnical investigations.

Level of Significance before Mitigation: With implementation of RR GEO-1, Impact 5.6-3 would be less than significant.

Impact 5.6-4: Buildout of the Countywide Plan could subject people or structures to hazards from ground subsidence. [Threshold G-3 (part)]

Countywide Plan buildout would involve development of projects in areas of potential subsidence mapped on Figure 5.6-4. Of the four areas where most growth would occur, the Bloomington CPA and City of Fontana SOI in the Valley Region, and the Town of Apple Valley SOI in the North Desert Region, are in areas of medium to high potential subsidence risk; the East Valley Area Plan area in the Valley Region is in an area of medium to low potential subsidence risk.

Geotechnical investigations for each project would assess subsidence potential under their respective project sites and would provide any needed recommendations to minimize hazards from ground subsidence. Impacts would be less than significant.

Level of Significance before Mitigation: With implementation of RR GEO-1, Impact 5.6-4 would be less than significant.

Impact 5.6-5: Countywide Plan buildout could subject people or structures to hazards from expansive and collapsible soils. [Thresholds G-3 (part) and G-4]

Implementation of the Countywide Plan could subject people or structures to hazards from expansive soils and/or collapsible soils. 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 are weakly cemented and that thus can be collapse or be compressed with the addition of water or weight. Collapsible soils include young fine-grained alluvial materials and wind-deposited soils, and soils with salts.

The Valley Region is unlikely to have expansive soils except for two areas: one in Grand Terrace and the other in the Chino Hills area south of Chino Hills State Park. Areas with collapsible soils with moderate to high levels of salts include parts of San Bernardino, south Ontario, and Chino. The three portions of the Valley Region where most growth would occur—Bloomington CPA, City of Fontana SOI, and East Valley Area Plan area—are not in any of those areas of hazardous soils.

Soils in several areas of the Mountain Region are moderately expansive, including Crestline, Lake Arrowhead, Big Bear Lake, Running Springs, and Barton Flats. However, collapsible soils are less likely in the Mountain Region, which typically receives more precipitation than other areas of the county.

Much of the Desert Regions has low to moderately expansive soils. In select areas, such as Lucerne Valley and dry lakebeds, the soils can be highly expansive. The Desert Regions have the highest potential for collapsible soils due to its aridity, the prevalence of both alluvial and wind-deposited soils, and soils with salts. The Town of Apple Valley SOI is not in a dry lakebed and thus is not in an area of highly expansive soils identified above.

Each development project under the Countywide Plan would conduct a geotechnical investigation of its site that would assess the suitability of site soils for supporting the proposed structures. Such assessments would address expansion potential and collapsibility; and would provide any needed recommendations to minimize hazards arising from expansive and/or collapsible soils, including removal of soils unsuitable for supporting proposed structures and placement of engineered fill soils. Impacts would be less than significant after compliance with recommendations of geotechnical investigation reports.

Level of Significance before Mitigation: With implementation of RR GEO-1, Impact 5.6-5 would be less than significant.

Impact 5.6-6 Countywide Plan buildout could involve construction of septic tanks on soils inadequate for supporting the tanks. [Threshold G-5]

Portions of the unincorporated areas in each of the County's four regions rely on septic tanks for wastewater disposal. Thus, buildout of the Countywide Plan is expected to involve some development using septic tanks. Soils in some areas may not be suitable for supporting septic tanks. A soil percolation test would be required before construction of each septic tank (County Code Section 33.0894). Furthermore, the County allows septic tanks on slopes up to 45 percent. However, for systems with a slope of 30 percent or more, slope stability analyses need to be approved by the Land Use Services Department prior to issuance of a building permit. Impacts would be less than significant after performance of percolation tests, adherence to the recommendations of the professionals conducting the tests, and the approval of the Land Use Services Department where required.

Level of Significance before Mitigation: With implementation of RR GEO-2, Impact 5.6-6 would be less than significant.

5.6.5 Cumulative Impacts

Geology and soils impacts related to the proposed project would be specific to the sites of each development or redevelopment project under the Countywide Plan and its users and would not be common or contribute to the impacts (or shared with, in an additive sense) on other sites. Compliance with applicable state and local building regulations would be required of all development. Individual projects would be designed and built in accordance with applicable standards in the CBC and the individual building regulations of local jurisdictions (see RR GEO-1), including pertinent seismic design criteria. Site-specific geologic hazards would be addressed by the Engineering Geologic Report, Supplemental Ground-Response Report, and/or Geotechnical Report required for each development project. These geologic investigations would identify the specific geologic and seismic characteristics on a site and provide guidelines for engineering design and construction to maintain the structural integrity of proposed structures and infrastructure. Therefore, compliance with applicable state and local building regulations and standard engineering practices related to seismic and geologic hazard reduction would prevent significant cumulative adverse impacts associated with geologic and seismic hazards.

Impacts of the proposed Project and other development projects on geology and soils would not be cumulatively significant providing that projects remain in compliance with existing regulations and implement site-specific mitigation measures.

5.6.6 Level of Significance Before Mitigation

With the implementation of RRs GEO-1, GEO-2, and/or HYD-1, all impacts would be less than significant.

5.6.7 Mitigation Measures

No mitigation is required.

5.6.8 Level of Significance After Mitigation

Impacts would be less than significant.

5.6.9 References

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