3.11 GEOLOGY AND SOILS

3.11.1 INTRODUCTION

This PEIR section provides a description of the geologic and seismic setting of the proposed project's Planning Area. In addition, potential impacts associated with implementation of the proposed project are assessed and mitigation measures are recommended, as needed, in order to avoid or reduce the significance of such impacts. Risks associated with natural hazards including earthquake faults, strong seismic ground shaking, and seismic-related ground failure (i.e., liquefaction, landslides, and/or unstable geologic units or soils) are evaluated.

3.11.2 ENVIRONMENTAL SETTING

The information contained in this Environmental Setting section is based upon information contained in the City of Lake Elsinore General Plan Background Reports (see Chapter 12 – Geology and Mineral Resources). This document is attached as Appendix B to this PEIR.

GEOLOGIC STRUCTURE

The City of Lake Elsinore and its SOI are located in the northern part of the Peninsular Ranges Province and includes parts of two structural blocks, or structural subdivisions of the province. The Peninsular Ranges province extends from the Santa Monica Mountains approximately 900 miles south to the tip of Baja California. It is located on the Pacific (tectonic or crustal) Plate, which is moving to the northwest relative to the adjacent North American Plate. The well-known San Andreas Fault forms the boundary between the Pacific and the North American Plates. As a result, the Southern California area contains numerous regional and local faults, and experiences substantial ground movement during frequent seismic events.

The active Elsinore fault zone diagonally crosses the southwest corner of the Elsinore quadrangle and is a major element of the right-lateral strike-slip San Andreas fault system. The Elsinore fault zone separates the Santa Ana Mountains block west of the fault zone from the Perris block to the east. Internally, both blocks are relatively stable and, within the quadrangle, are characterized by the presence of widespread erosional surface of low relief. Within the quadrangle, the Santa Ana Mountains block is underlain by undifferentiated granitic rocks of the Cretaceous Peninsular Ranges batholith, but to the west includes widespread pre-batholithic Mesozoic rocks.

The Elsinore Fault Zone forms a complex series of pull-apart basins. The largest and most pronounced of these pull-apart basins forms a flat-floored closed depression, ***La Laguna***, in which the City of Lake Elsinore is located and which is partly filled by Lake Elsinore. This basin forms the terminus for the San Jacinto River. During excessively wet periods the La Laguna (Lake Elsinore) fills and the overflow passes through Warm Springs Valley into Temescal Wash, which joins the Santa Ana River at Corona. La Laguna (Lake Elsinore), bounded by active faults, is flanked by both Pleistocene and Holocene alluvial fans emanating from both the Perris block and the Santa Ana Mountains. North of La Laguna are exposures of the Paleocene Silverado Formation. Clay beds of the Silverado Formation have been an important source of clay. Overlying the Silverado Formation are discontinuous exposures of conglomeratic younger Tertiary sedimentary rocks that are tentatively correlated with the Pauba Formation.

Elevations on the valley floor are approximately 1,240–1,255 feet above mean sea level. The valley is bounded to the west by the faulted east flank of the rugged Santa Ana Mountains; the portion of the uplift immediately west of Lake Elsinore is sometimes referred to as the Elsinore Mountains, although it is physically continuous with the rest of the Santa Ana range. Maximum elevations in the Santa Ana Mountains west of the valley reach 4,500 feet above mean sea level. The east margin of the valley is approximately defined by the Glen Ivy fault, a strand of the Elsinore system, and hilly topography to the east reflects active tectonism combined with differential erosion of diverse bedrock units.

West of the Elsinore Valley, the Santa Ana Mountains uplift is dominated by primarily granitoid rocks of the Cretaceous age belonging to the Peninsular Ranges batholith. Immediately above Lake Elsinore, the granitic rocks are primarily potassium feldspar bearing tonalite and granodiorite.[1] Bodies of biotite and hornblende granodiorite are present to the northwest and southwest; farther to the west, hornblende gabbro occurs locally.[2] Roof pendants[3] consisting of metasedimentary rocks of Mesozoic age are also locally present to the west. To the west and north, siliceous metasediments of the Jurassic Bedford Canyon Formation are exposed in a broad east–west-trending belt.[4] Underlying the Bedford Canyon

Formation and exposed to the southeast of Santiago Peak, is the granitic core of the mountains. The large, round, white, granodiorite boulders are easily seen from the Lower San Juan Creek Campground, over the summit of the Ortega Highway, and along the eastern flank of the mountains above Lake Elsinore.

In areas where drainages diverge and spread out on the valley floor, alluvial fan deposits comprised of gravel, sand, and silt and ranging in age from mid-Pleistocene to Holocene are present; unconsolidated Holocene deposits of bouldery to sandy alluvium are present in active and recently active drainage channels. Geologic Formations in the Elsinore Valley area are shown in **Figure 3.11-1, Geologic Formations**.

---

[1] The term “granitic rocks” includes granodiorite and tonalite as well as granite, and as used by some geologists may include quartz syenite to quartz diorite.

[2] Granites may be divided into three major types: calc-alkaline, peraluminous, and alkaline. Calc-alkaline granites typically are biotite or biotite-hornblende granites, some contain augite, and sphene is a common accessory.

[3] A roof pendant is a downward extension of the surrounding rock that protrudes into the upper surface of intrusive rocks. Most intrusions that contain roof pendants are relatively shallow; the roof pendants occur as isolated pieces of the surrounding rock within the intrusive mass. Because roof pendants are exposed by erosion of the overlying rock, their presence indicates that the igneous body is being observed near its upper surface.

[4] The highest, northern-most peaks in the range are composed of Triassic-Jurassic Period metasedimentary rocks of the Bedford Canyon Formation. This formation contains the oldest exposed rocks in Orange County which were formed during the earliest part of the great "Age of Reptiles", about 225 million years ago. These rocks include argillite, quartzite, slate, and small exposures of shale and limestone which contain poorly preserved mollusk fossils.

The Elsinore Valley itself is floored primarily by unconsolidated sand, silt, and clay of latest Pleistocene and Holocene age, recording riverine drainage along the valley axis. Immediately surrounding Lake Elsinore is a broad expanse of late Holocene lake deposits consisting of gray, fine-grained sediments that represent the lake's former extent.

Soils of the City, SOI, and surrounding areas were mapped by the USDA's Natural Resources Conservation Service, in 1971.[5] The following soils discussion is based on USDA soils mapping.

Five soil associations occur within the planning area. The four soil types are: Cajalco-Temescal-Las Posas; Hanford-Tujunga-Greenfield; Cieneba-Rock Land-Fallbrook; and Friant-Lodo-Escondido.

Cajalco-Temescal-Las Posas (CTLP). The Temescal Valley, including the mouth of Temescal Wash, and a significant portion of the City east and west of I-15 is underlain by soils assigned to the Cajalco-Temescal-Las Posas soils association, The CTLP association consists of well-drained, undulated to steep, moderately deep to shallow soils that formed on gabbro or latite bedrock and have a surface layer of fine sandy loan and loam. Soils of this association are suitable to support pasturage, irrigated agriculture, development, recreational uses, and wildlife habitat.

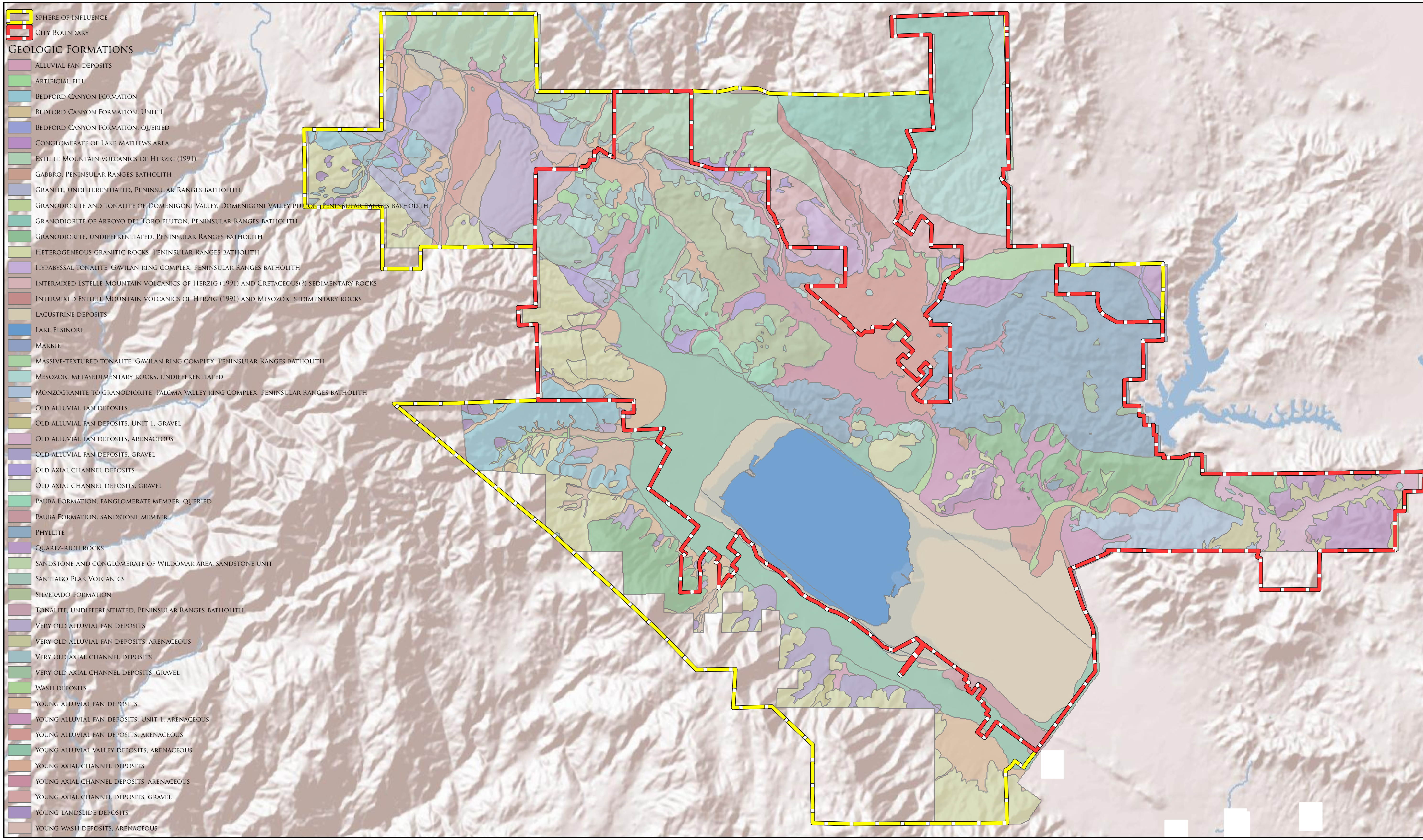
Hanford-Tujunga-Greenfield (HTG). The Elsinore Valley floor surrounding the lake is underlain primarily by soils assigned to the Hanford-Tujunga-Greenfield association, which occurs on alluvial fans and flood plains. The HTG, soils association is comprised of very deep, well drained to excessively drained, nearly level to moderately steep soils that have a surface layer of sandy to sandy loam developed out of granitic alluvium. Soil stability is considered poor to fair with significant erosion potential. Soils of this association are suitable to support dry farming, irrigated agriculture, and development.

Friant-Lodo-Escondido (FLE). The eastern portion of the City, and adjacent SOI area is underlain by soils of the Friant-Lodo-Escondido association, which is comprised of well drained to somewhat excessively drained shallow to deep soils formed on metasedimentary (metasandstone and mica schist) bedrock. The surface layer consists of fine sandy loam and gravelly loam. Soils of this association support dry farming, irrigated agriculture, recreational uses, and wildlife habitat.

Cineba-Rock Land-Fallbrook (CRLF). From Canyon Lake to Lake Elsinore, the San Jacinto River and Cottonwood Creek drainages are underlain by the Cieneba-Rock Land-Fallbrook association, which is comprised of well-drained to somewhat excessively drained, very shallow to moderately deep, upland soils formed on granitic bedrock. The surface layer consists of sandy loam and fine sandy loam. Soils of this association are suitable to support pasturage and dry farming, irrigated agriculture, development, and wildlife habitat.

[5] USDA, Soils Survey Western Riverside, California, 1971

This page intentionally left blank.



Sources: City of Lake Elsinore, County of Riverside

N

0 1 2 Miles

City of Lake Elsinore
Geologic Formations
Figure 3.11-1

This page intentionally left blank.

FAULTS

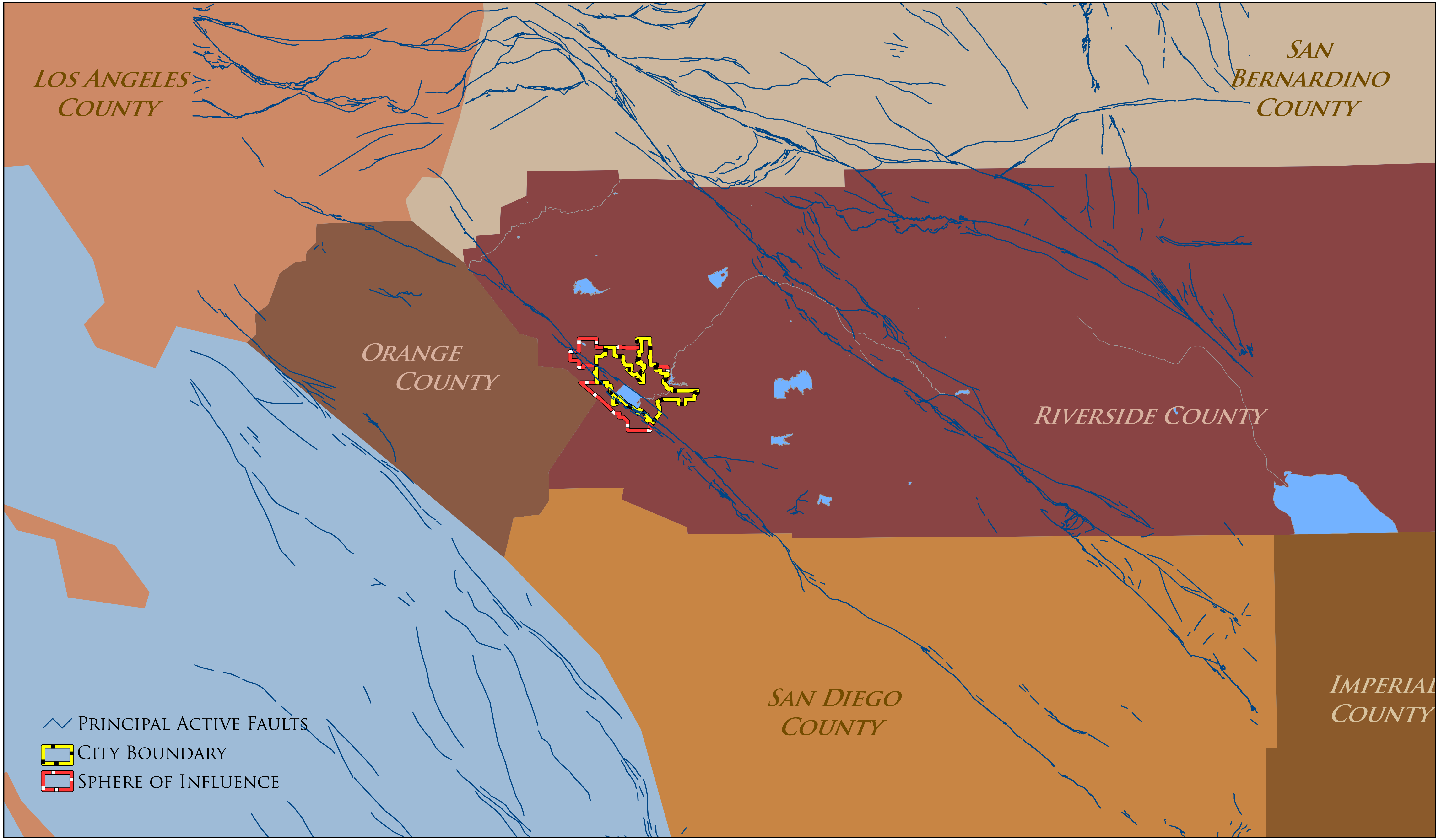
The City is located within a seismically active region of California, with a number of known active faults present. These faults are described below and in **Table 3.11-1, Faults and Fault Zones Impacting Elsinore Valley**, and illustrated on **Figure 3.11-2, Approximate Traces of Principal Active Faults of the Peninsular Ranges and Mojave Desert near Lake Elsinore**. Many faults have the potential to generate strong ground shaking, surface fault rupture and secondary damage in the western Riverside County area.

Visual evidence of faults generally occurs when land movement results in the repeated displacement of earth, causing a linear fracture, or fault trace, on the earth's surface. The California State Mining and Geology Board defines an active fault as one that has "had surface displacement within Holocene times (approximately the last 11,000 years);" however, this definition does not mean that faults lacking visual evidence of surface displacement within the Holocene times are necessarily inactive, and may instead be assumed to be inactive based on geologic evidence. Active faults are generally those faults having shown evidence of surface displacement during the Quaternary time (last 1.6 million years).

Table 3.11-1, Faults and Fault Zones Impacting the City of Lake Elsinore

FAULT NAME	TYPE	PROBABLE MAGNITUDE	INTERVAL BETWEEN MAJOR RUPTURES
San Andreas Fault	Right-lateral strike-slip	M 6.8 – 8.0	140 years
Elsinore Fault Zone	Right-lateral strike-slip	M 6.5 – 7.5	250 years
Strands of the Elsinore Fault Zone			
Wildomar Fault			
Glen Ivy South		Unknown	Unknown
Glen Ivy North			
San Jacinto Fault	Right-lateral strike-slip	M 6.5 – 7.5	100-300 years
Laguna Salada Fault Zone	Right-lateral strike-slip; right-lateral normal oblique	M 6.5 – 7.5	Unknown
Whittier Fault	Right-lateral strike-slip	M 6.0 – 7.2	Unknown
Chino Fault	Right-reverse	M 6.0 – 7.0	Unknown

This page intentionally left blank.



Sources: City of Lake Elsinore, County of Riverside, California Department of Forestry & Fire Protection

City of Lake Elsinore Dream Extreme

Approximate Traces of Principal Active Faults of the Penninsular Ranges and Mojave Desert Near Lake Elsinore

Figure 3.11-2

This page intentionally left blank.

San Andreas Fault Zone.

Because of its relatively frequent, large earthquakes, the San Andreas fault is considered the *Master Fault*, controlling the seismic hazard in southern California. In the vicinity of Riverside County, the San Andreas fault zone is comprised of three segments: (1) the San Bernardino Mountains segment, (2) the Coachella Valley segment, and (3) the Mojave Desert segment. Between Cajon and San Gorgonio Passes, the County is bisected by the San Bernardino segment. The Coachella Valley segment runs along the northeastern margin of the Coachella Valley.

The last major earthquake on the southern San Andreas fault was the 1857 Mw 8.0 Fort Tejon quake that ruptured the San Andreas from central California to the Cajon Pass, about 15 miles north of the County. For purposes of discussing the potential impact of the San Andreas fault on Lake Elsinore, the "southern segment" of the fault is considered a simultaneous rupture of the San Bernardino and Coachella Valley segments. Paleoseismic evidence indicates that such simultaneous rupture has occurred at least twice since 1450. The Working Group on California Earthquake Probabilities (1995) estimated that the San Bernardino segment has a 28% probability of rupturing in the time period between 1994 and 2024. An earthquake of magnitude 7.3 on the San Bernardino Mountains segment could produce peak horizontal ground accelerations as high as 0.53 g in Riverside County. If this fault segment were to break along with the Coachella segment, a large portion of the County would be subjected to strong ground motions. The Coachella Valley segment itself has an estimated 22% probability of rupturing before the year 2024 and is estimated capable of producing a magnitude 7.1 earthquake.

San Jacinto Fault Zone.

The San Jacinto fault zone consists of a series of closely spaced faults that form the western margin of the San Jacinto Mountains. The fault zone extends from its junction with the San Andreas fault in San Bernardino, southeasterly toward the Brawley area, where it continues south of the international border as the Imperial transform fault. The San Jacinto fault zone has a high level of historical seismic activity, with at least ten damaging (Mw6-7) earthquakes having occurred on this fault zone between 1890 and 1986. The segments of the fault of most concern in Riverside County are the San Bernardino, San Jacinto Valley, and Anza segments. The Working Group on Southern California Earthquake Probabilities (1995) has estimated that the San Bernardino, San Jacinto, and Anza segments have a 37%, 43%, and 17% probability respectively of rupturing in the period between 1994 and 2024. Two of its most seismically active segments (the Casa Loma and Clark faults) are located in close proximity to Lake Elsinore, in Perris and Hemet respectively. Maximum credible earthquakes of magnitudes 6.7, 6.9, and 7.2 are expected on the San Bernardino, San Jacinto Valley, and Anza segments respectively, capable of generating peak horizontal ground accelerations of 0.48 to 0.53 in Riverside County.

Elsinore Fault Zone.

The Elsinore fault zone parallels the San Jacinto and is part of the same right-lateral crustal plate strain system as the San Andreas and San Jacinto. The Elsinore fault zone is one of the longest in Southern California, and in historic times, has been one of the quietest. Segments in Riverside County are the Whittier, Glen Ivy, Temecula, and Julian segments. Maximum credible earthquakes for Mw6.7 to 6.8 are assigned for the Chino, Whittier, Glen Ivy, and Temecula segments of the Elsinore fault. Major ground rupturing events on these fault segments would generate ground accelerations of 0.47 to 0.48 in Riverside County. The Working Group estimates probabilities of 5% to 16% for these seismic events to occur in the 1994 to 2024 time period. The southeastern extension of the Elsinore fault zone, the Laguna Salada fault, ruptured in 1892 in a magnitude 7 quake and a magnitude 7.2 quake in 2010; however, the main trace of the Elsinore fault zone has only seen one historical event greater than magnitude 5.2: the earthquake of 1910, a magnitude 6 shock near Temescal Valley that produced no known surface rupture and did little damage.

The Elsinore Valley was formed by seismic activity in the Elsinore fault system, the northern portion of which runs northwest to southeast through the GPU planning area. In the City of Lake Elsinore, the majority of the Elsinore fault zone is located under the Lake. **Figure 3.11-2** shows the active fault systems in the vicinity of the planning area. Pursuant to the requirements of the *Seismic Hazards Mapping Act*, the state is in the process of creating localized seismic hazards maps to be overlain on USGS quadrangle maps. A map has not yet been issued for the Lake Elsinore quadrangle map but has been completed for the adjacent Murrieta/Temecula quadrangle to the south and maps are planned for the Lake Elsinore and Wildomar quadrangles within the next decade.

Cucamonga Fault Zone.

The Cucamonga fault zone is a youthful member of the Transverse Ranges family of thrust faults (Morton and Matti, 1987) and is the eastward extension of the Sierra Madre fault, one of the most hazardous of southern California's faults. Though the fault is not located in Riverside County it does create a hazard within the County. The Cucamonga fault zone is the Transverse Ranges fault that is closest to Riverside County. The fault is capable of producing a maximum magnitude of 7.0.

Seismic Hazards

The Riverside County *Multi-Jurisdictional Local Hazard Mitigation Plan* (LHMP) states that earthquake risk is very high in the most heavily populated western portion of Riverside County due to the presence of two of California's most active faults: the San Andreas and the San Jacinto.

The Hazards U.S. Multi-Hazard (HAZUS-MH) is a nationally applicable standardized methodology that estimates potential losses from earthquakes, hurricane winds, and floods. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). As part of its participation in the preparation of the County of Riverside's LHMP (2005) the City of Lake Elsinore and the County of Riverside used the HAZUS model to estimate direct economic losses in the City of Lake Elsinore of $321 million in the event of a Mw 6.9 (maximum credible earthquake) earthquake on the Elsinore fault, with the epicenter near Lake Elsinore (**Table 3-11.2, Summarized HAZUS Results – M6.9 Quake on Elsinore Fault Epicenter – Near Lake Elsinore**). Most of the estimated losses would be due to building damage.

Table 3-11.2, Summarized HAZUS Results – M6.9 Quake on Elsinore Fault Epicenter – Near Lake Elsinore

DIRECT ECONOMIC LOSS ESTIMATES (THOUS. $)	
Structural Damage	$44,661.19
Non-Structural Damage	$186,271.73
Building Damage	$230,932.92
Contents Damage	$59,213.14
Inventory Loss	$1,657.72
Relocation Cost	$1,009.34
Income Loss	$7,945.15
Rental Income Loss	$11,679.34
Wage Loss	$8,542.80
TOTAL LOSS	**$320,980.37**
Source – Riverside County Multi-Jurisdictional Local Hazard Mitigation Plan, Part II – Lake Elsinore (2005)	

The following types of ground failure could occur within the City of Lake Elsinore and its SOI due to seismic activity:

Fault Rupture.

The California Geological Survey places active faults with surface expression within a zone referred to as an Alquist-Priolo Earthquake Fault Zone. Earthquake Fault Zones are regulatory zones around active faults. These Zones are defined by turning points connected by straight lines. Most of the turning points are identified by roads, drainages, and other features on the ground. The zones vary in width, but average about one-quarter mile wide. The delineation of the Earthquake Fault Zones is intended to prohibit construction of new habitable structures near or on active faults within California, for the purposes of protecting human health and safety. The City of Lake Elsinore and its SOI are affected by the Elsinore Fault Earthquake Fault Zone. The zone is mapped to north of the northern boundary of the City and continues south of the City boundary. Since the Elsinore fault is known to continue through the City of Lake Elsinore, it is assumed that the fault is as active within the City's corporate boundaries as it is on either side of those boundaries; rupture of a known earthquake fault can be anticipated.

The last recorded ground rupture on the Elsinore fault occurred in 2010 in vicinity of the Laguna Salada segment in Baja California. The last earthquake over magnitude 5.2 along the main trace of the Elsinore fault was a Mw 6 quake near the Temescal Valley in 1910 that produce no known surface rupture. Lesser magnitude earthquakes have occurred along the Elsinore fault zone in 1890, 1918, 1923, 1937, 1954, 1968, and 1982. Accordingly, although the Elsinore fault complex is active, it is unlikely that the City and SOI would be subject to surface rupture during a seismic event.

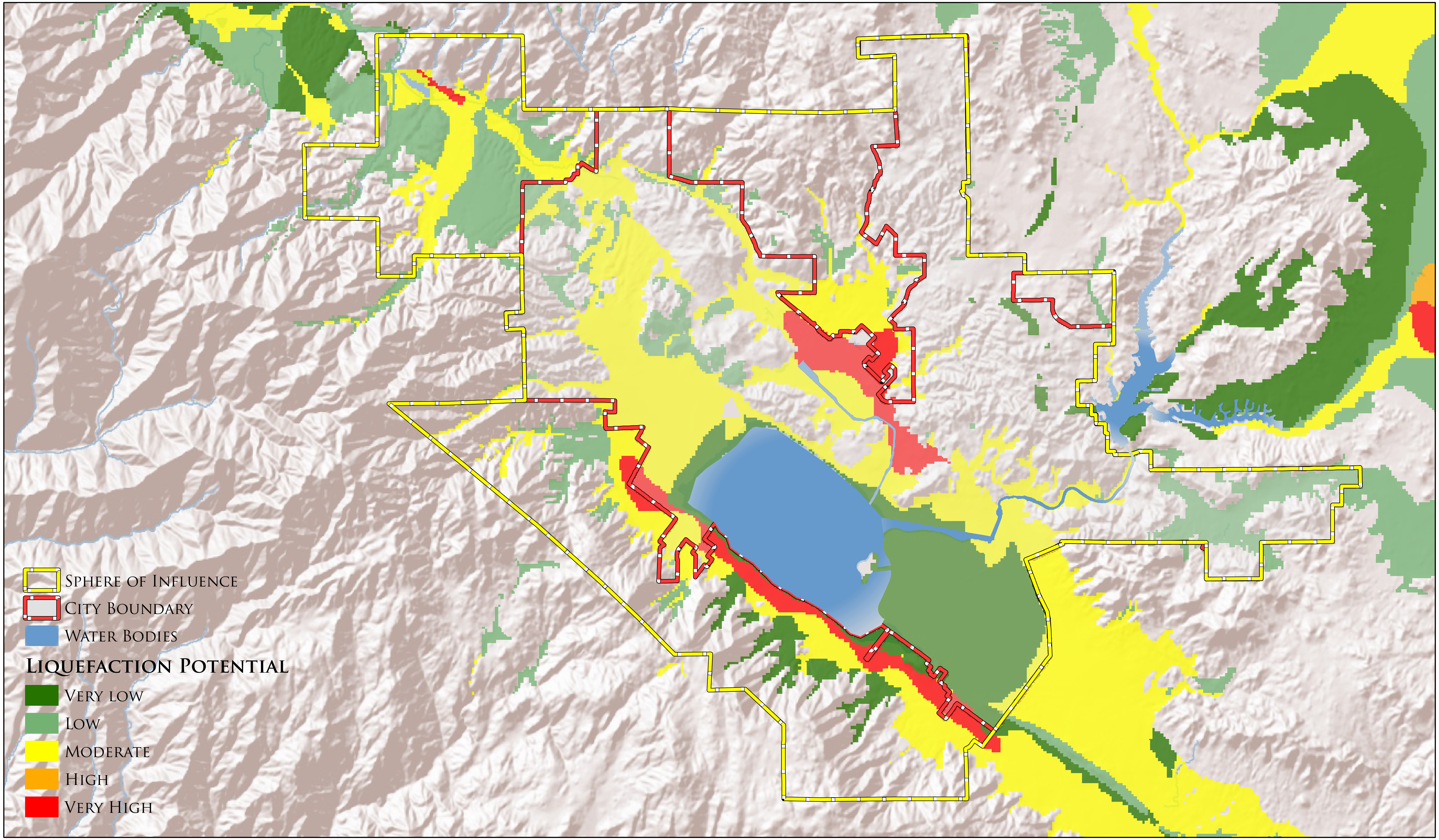
Seismic Ground Shaking.

Ground motions are typically measured in percentage of gravity (g, the acceleration due to gravity), where g is approximately 32 feet per second (9.8 meters per second per second). The City is located within a seismically active region of California, with a number of earthquakes occurring over the past 200 years. Geologic studies conducted for the region indicate that seismic activity greater than Magnitude 5.0 on the Richter Scale in the Lake Elsinore area is associated with known active faults in the region. The Elsinore Area Plan within the Riverside County General Plan, and the County LHMP identify the faults that are capable of causing potential damage within the Lake Elsinore area; refer also to **Table 3.11-1**. There are several faults capable of generating peak ground accelerations of over 0.10 g in the vicinity of Lake Elsinore. Accordingly, the possibility of moderate to high ground acceleration or shaking in the City may be considered as approximately similar to the Southern California region, as a whole.

Liquefaction.

Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause underlying soils to liquefy and temporarily behave as a dense fluid. For liquefaction to occur, intense seismic shaking, the presence of loose granular soils prone to liquefaction, and the saturation of soils due to shallow groundwater need to occur simultaneously. Such actions result in a sudden temporary increase in pore water pressure, or liquefaction. Liquefaction more often occurs in earthquake-prone areas underlain by young (Holocene age) alluvium where the groundwater table is shallower than 50 feet below the ground surface.

Figure 3.11-3, Liquefaction Susceptibility in Lake Elsinore Area, illustrates the areas in the City susceptible to liquefaction. In general, liquefaction susceptibility within the planning area ranges from very low in the former lake footprint to high to moderate on portions of the remainder of the valley floor, to very high in the valley floor corridor formerly occupied by the axial riverine drainage. Liquefaction potential is also very high along the area's principal tributary drainages and on portions of the alluvial fans on the valley's eastern margin.



Sources: City of Lake Elsinore, County of Riverside

City of Lake Elsinore Dream Extreme

Liquefaction Susceptibility in Lake Elsinore Area
Figure 3.11-3

This page intentionally left blank.

Lateral Spreading.

Lateral spreading is caused by the lateral displacement of surficial blocks of sediment, as a result of liquefaction in subsurface layers. Lateral spreading is associated with areas prone to liquefaction, as described above. Portions of the City on the Valley floor have very high to moderate susceptibility for lateral spreading, coinciding with those areas that are prone to liquefaction.

Ground Lurching.

Lurching typically results where loose to poorly consolidated soil deposits on or adjacent to steep slopes move laterally as the result of strong ground shaking during a seismic event. Areas that are underlain by steep contacts of dissimilar bearing materials at depth, such as compacted fill caps that have been placed over a transition from bedrock to Holocene age alluvium, are also subject to lurching.

During seismic events, wave-like occurrences have been sighted during intense seismic ground shaking on certain soils, often resulting in surface ridges or cracks. Areas underlain by thick accumulations of colluvium and alluvium appear to be more susceptible to ground lurching than bedrock. Lurching can be expected within loose, cohesionless solids, or in clay-rich soils with high moisture content under strong seismic ground motion conditions. More heavily loaded structures appear to be less susceptible to the effects of ground lurching, generally due to methods of construction and building materials. Typically, ground lurching poses a greater potential for damage to lightly-loaded structures such as pavement, fences, pipelines, and walkways.

Seismically-Induced Ground Settlement.

Ground shaking can result in ground settlement as sediment particles become more tightly packed, thereby reducing pore space. Such unconsolidated, loosely packed alluvial deposits are especially susceptible to seismically-induced ground shaking. In addition, artificial fills that are poorly compacted may also be subject to seismically-induced settlement.

GEOLOGIC HAZARDS

Landslides.

Landslides are large movements of the underlying ground that include rock falls, shallow slumping and sliding of soil, and deep rotational or transitional movement of soil or rock.

Development along hillsides is particularly susceptible to landslides, as they are considered to be a basic geologic hazard for such development. Seismically induced landsliding and rock falls can be expected to occur throughout Riverside County, including the City of Lake Elsinore, in a major earthquake. In addition to seismic causes, landslides may also be triggered by soil saturation during periods of heavy rains, which can cause soils to lose cohesion and fall down the slope. Factors controlling the stability of slopes include: 1) the slope height and inclination,

2) the engineering characteristics of the earth materials comprising the slope, and 3) the intensity of ground shaking. Landslides can compromise the integrity of structures and infrastructure existing on the slope and inundate areas below.

As shown in **Figure 3.3-8, Percent Slope,** in Section 3.3 (Aesthetics) of this PEIR, a substantial proportion of the City and its SOI contain slopes of 30 percent or steeper, and much of that area is at substantial risk of seismically induced slope failure. Both the Riverside County General Plan and the Elsinore Area Plan include maps showing areas of general slope failure hazard. Wilson and Keefer (1985) have reported that a ground acceleration of at least 0.10 g in steep terrain is necessary to induce earthquake-related rock falls, although exceeding this value does not guarantee that rock falls will occur. Since there are several faults capable of generating peak ground accelerations of over 0.10 g in the vicinity of Lake Elsinore, there is a high potential for seismically induced rock falls and landslides to occur.

Pursuant to the Seismic Hazards Mapping Act, the State of California is in the process of creating localized seismic hazards maps to be overlain on USGS quadrangle maps. Maps have not yet been issued for the Lake Elsinore quadrangle map; however, mapping has been completed in the Murrieta and Temecula quadrangle, which includes the southern portion of the Lake Elsinore SOI, and is planned for the Lake Elsinore and Wildomar quadrangles during the next decade.

Slope Stability.

Generally, slopes that are subject to failure are formed along bluffs and foothills located within the City of Lake Elsinore both east and west of I-15. Manufactured slopes (i.e., cut and/or fill slopes) and the natural stability of slopes can be influenced by underlying geologic structures, strength of materials, height, and the inclination and orientation of manufactured slopes. A substantial portion of the City and its SOI contain slopes of 30 percent or more or are adjacent to areas susceptible to soil slips, soil slumps, or debris flows.

Expansive Soils.

Expansive soils are composed of a significant amount of clay particles which can expand (absorb water) or contract (release water). These shrink and swell characteristics can result in structural stress and place other loads on these soils. Expansive soils are often associated with geologic units having marginal stability and can occur in low-lying alluvial basins, as well as along hillside areas. It is possible to build successfully and safely on expansive soils if stable moisture content can be maintained or if the building can be insulated from any soil volume change that occurs. The City of Lake Elsinore requires testing to identify any problems, and soil preparation and structural foundation design to minimize moisture content changes and insulate from soil volume changes as a way of mitigating for the effects of expansive soils on new structures. While there is currently no soil mapping that identifies specific areas within the City and SOI that are subject to expansive soils, such soils are known to exist in the City and its SOI.

Corrosive Soils.

Soil corrosion is a complex phenomenon, with a number of variables involved. Chemical reactions involving almost each of the existing elements are known to take place in soils, many of which are not yet fully understood. The relative importance of variables changes for different materials, making a universal guide to corrosion impossible. Variations in soil properties and characteristics across three dimensions can have a major impact on corrosion of buried structures. For metals in soil or water, corrosion is typically a result of contact with soluble salts found in the soil or water. This process requires moisture to form solutions of the soluble salts. Factors that influence the rate and amount of corrosion include the amount of moisture, the conductivity of the solution (soil and/or water), the hydrogen activity of the solution (pH), and the oxygen concentration (aeration). Other factors such as soil organic content, soil porosity, and texture indirectly affect corrosion of metals in soil by affecting the other factors listed above. The City of Lake Elsinore requires testing for corrosive soils as part of the soils and geotechnical reporting demanded of all new construction projects.

Subsidence.

The overdrafting of aquifers is the major cause of subsidence in the southwestern United States, and as ground-water pumping increases, land subsidence also will increase. In many aquifers, ground water is pumped from pore spaces between grains of sand and gravel. If an aquifer has beds of clay or silt within or next to it the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure is a loss of support for the clay and silt beds. Because these beds are compressible, they compact (become thinner), and the effects are seen as a lowering of the land surface. The lowering of land surface elevation from this process is permanent. For example, if lowered ground-water levels caused land subsidence, recharging the aquifer until ground water returned to the original levels would not result in an appreciable recovery of the land-surface elevation.

Subsidence and fissuring have been well-documented in Riverside County since the early 1960s. Most of the early cases affected only agricultural land or open space. Since the late 1980s, increased urbanization has seen impact on structures designed for human occupancy. In Riverside County, subsidence and fissuring have been caused by falling groundwater tables and by hydrocollapse when groundwater tables rise. In addition, many fissures have occurred along active faults that bound the San Jacinto Valley and Elsinore Trough. Some controversy surrounded the initial recognition of these features in the late 1980s and early 1990s. However, there is agreement on the geotechnical conditions that can lead to subsidence and earth fissure formation.[6]

In the Elsinore Valley, subsidence has been attributed to groundwater pumping. Groundwater levels are generally declining throughout the basin. Average declines have been about 15 feet per year throughout the basin over the past 20 years. This decline in water levels increases the risk for land subsidence particularly in the Back Basin area. EVMWD is currently in the process of implementing a subsidence-monitoring program in the Elsinore Basin area.

[6] *Slope and Soil Instability Hazards-County of Riverside* August 1, 2000 Earth Consultants International Page 2-18

To ensure that buildings located in areas subject to liquefaction and/or lateral spreading are designed to avoid failure in the event of seismically-induced liquefaction, the City of Lake Elsinore enforces the provisions of Chapter 18 in the 2010 California Building Code and require an owner or applicant to submit a full foundation and soils investigation, performed by an approved civil engineer professionally licensed by the State of California, to the Planning and Building Department prior to issuance of building permits for all new construction. Such a report would identify the presence of soils subject to liquefaction on the building site and would provide recommendations for the design and construction of building foundations that would mitigate the effects of seismically induced liquefaction or lateral spreading. However, older structures located in Liquefaction Susceptibility Zones in the Elsinore area that were not designed to current standards could fail as a result of seismically-induced liquefaction.

GEOTHERMAL RESOURCES

The region's principal renewable geologic resource is geothermal power.

The Elsinore fault system features many active hot springs that can serve as sources for geothermal energy. Geothermal resources associated with elevated heat flow along the Elsinore fault zone have been known for some time. Native Americans and early settlers are believed to have used the area's hot springs for therapeutic purposes; in the 19th century the town of Elsinore (now the City of Lake Elsinore) became famous for its sulfur waters, which supported a local spa industry that experienced a boom in popularity in the early 20th century. The region's largest hot springs are at Murrieta Hot Springs near Temecula, along the principal trace of the Elsinore fault. Smaller hot springs are present in a number of places along splay faults. The planning area contains one major geothermal spring, located near the northeastern banks of Lake Elsinore.

To date, the SOI's geothermal resources associated with elevated heat flow along the Elsinore Fault zone have not been developed for energy production, although the Riverside County General Plan does identify some potential for such utilization.

3.11.3 REGULATORY SETTING

FEDERAL

There are no federal regulations pertaining to geology and soils relevant to the proposed project.

STATE

California Building Code (2010)

The California Health and Safety Code, Section 17958 mandates that the California Building Standards Commission adopt and publish the California Building Standards Code (California

Code of Regulation, Title 24) every three years. The 2010 California Building Code (CBC) contains administrative regulations for the California Building Standards Commission and for all state agencies that implement or enforce building standards. All development within the State must demonstrate conformance with the requirements of the CBC, subject to review by the local agencies. Cities and counties are allowed to modify or amend building standards beyond those given in the CBC to address building standards on a local level.

Alquist-Priolo Earthquake Fault Zoning Act (1972).

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 2621 et seq.) was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards.

The Act requires the State Geologist to establish regulatory zones, known as "Earthquake Fault Zones," around the surface traces of active faults and to issue appropriate maps. Earthquake Fault Zones were called "Special Studies Zones" prior to January 1, 1994. Local agencies must regulate most development projects within these zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (typically 50 feet set backs are required).

Effective June 1, 1998, the Natural Hazards Disclosure Act requires that sellers of real property and their agents provide prospective buyers with a "Natural Hazard Disclosure Statement" when the property is being sold lies within one or more State-mapped hazard areas, including Earthquake Fault Zones.

Seismic Hazards Mapping Act (1990)

The Seismic Hazards Mapping Act (SHMA) of 1990 (Public Resources Code Section 2690 et seq.) directs the Department of Conservation, California Geological Survey to identify and map areas prone to liquefaction, earthquake-induced landslides and amplified ground shaking. The purpose of the SHMA is to minimize loss of life and property through the identification, evaluation and mitigation of seismic hazards.

The SHMA provides a statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other seismic hazards caused by earthquakes. Mapping and other information generated pursuant to the SHMA is to be made available to local governments for planning and development purposes. The State requires: (1) local governments to incorporate site-specific geotechnical hazard investigations and associated hazard mitigation, as part of the local construction permit approval process; and (2) the agent for a property seller or the seller if acting without an agent, must disclose to any prospective buyer if the property is located within a Seismic Hazard Zone. The State Geologist is responsible for compiling seismic hazard zone maps. The SHMA specifies that the lead agency or a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

LOCAL

Riverside County Operational Area Multi-Jurisdictional Local Hazard Mitigation Plan.

Riverside Operational Area (OA) developed the Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP) to create a safer community. The Riverside OA LHMP is the representation of Riverside OA's commitment to reduce risks from natural and other hazards, and serves as a guide for decision-makers as they commit resources to reducing the effects of natural and other hazards.

While the Disaster Mitigation Act of 2000 ("DMA 2000") requires that local communities address only natural hazards, the Federal Emergency Management Agency (FEMA) recommends that local comprehensive mitigation plans address man-made and technological hazards to the extent possible. Towards that goal, Riverside OA has addressed an expansive set of hazards.

For disasters declared after November 1, 2004, Riverside OA and the jurisdictions participating in the multi-jurisdictional effort, which includes the City of Lake Elsinore, must have an LHMP approved pursuant to §201.6 in order to receive FEMA Pre-Disaster Mitigation (PDM) project grants or to receive post-disaster Hazard Mitigation Grant Program (HMGP) project funding. The Multi-Jurisdictional LHMP is written to meet the statutory requirements of DMA 2000 (P.L. 106-390), enacted October 30, 2000 and 44 CFR Part 201 – Mitigation Planning, Interim Final Rule, published February 26, 2002.

City of Lake Elsinore Municipal Code - Title 15 (Building Code)

The California Building Code has been amended and adopted as Title 15 (Building Code) of the Lake Elsinore Municipal Code. Title 15 regulates all building and construction projects within the City limits. Through its implementation of the California Building Code, Title 15 provides a minimum standard for building design and construction. These minimum standards include specific requirements for seismic safety, excavation, foundations, retaining walls and site demolition. It also regulates grading activities including drainage and erosion control.

Lake Elsinore Municipal Code (LEMC) – Title 16, Chapter 16.24, Chapter 16.34 and Chapter 16.56

Chapter 16.56 (Improvements-Sanitary Sewer Facilities) of the Lake Elsinore Municipal Code addresses sewage disposal requirements within the City boundaries. Section 16.56.030 provides that where sanitary sewer service is not available, a private sewerage disposal system for each lot as required by the ordinance establishing standards for private sewage disposal systems shall be constructed. Additionally, Section 16.34.040 (Requirements for building permit issuance) establishes that "parcels shall be deemed served by City water and sewer if the distance in feet from the closest property line to the facility to be extended shall be 200 times the number of lots to be developed." Section16.24.040 (Information – Required) of Chapter 16.24 (Tentative Map) states that a "percolation test may be required if proposed sewage disposal involves percolation into the ground."

City of Lake Elsinore Municipal Code Title 17 (Zoning) Chapter 17.28

Provisions for a Fault Rupture Hazard Overlay Zone are set forth in Chapter 17.28 [(FR) Fault Rupture Hazard Overlay District] of the Lake Elsinore Municipal Code. The purpose of the Fault Rupture Hazard Overlay District is to protect life and property in the City of Lake Elsinore from hazards of geologic, faulting and set requirements for the evaluation of such areas prior to approval of any development permit or tentative map on the property. This Hazard Overlay District implements the policies of the Lake Elsinore General Plan and the provisions of the State of California Alquist-Priolo Special Studies Zones Act. The purpose of this overlay is to prohibit the location of most structures for human occupancy across traces of active faults and in landslide areas. The provisions of the Chapter require a Fault Rupture Hazard Analysis, prepared by a registered soils engineer/geologist, prior to the approval of any project located in a FR Overlay Zone.

When a special geologic study zone analysis identifies one or more significant geologic hazards in a project area, the project may be approved only by a written resolution which finds that:

A. Changes or alterations have been required in, or incorporated into, the project which mitigate or avoid the significant geologic hazards identified in the final analysis; and/or

B. Such changes or alterations are within the responsibility or jurisdiction of another public agency and such changes have been or can and should be adopted by that agency; and/or

C. Specific economic, social, or other considerations make infeasible the mitigation measures or project alternatives identified in the final analysis.

City of Lake Elsinore Municipal Code Title 17 (Zoning) Chapter 17.32

Chapter 17.28 [(PL) Potential Liquefaction Hazard Overlay District] of the Lake Elsinore Municipal Code describes the requirements of the City's Potential Liquefaction Hazard Overlay Zone. The purpose of the Potential Liquefaction Hazard Overlay District is to protect life and property in the City of Lake Elsinore from the effects of seismic activity in areas subject to liquefaction and ground lurching. This hazard overlay district implements the policies of the Lake Elsinore General Plan to promote the public health, safety and general welfare of its citizenry.

The purpose of this overlay is also to ensure the review of all proposed discretionary projects within identified potential liquefaction areas by professional soil engineers and the incorporation of site-specific recommendations and mitigation measures as conditions of approval.

All uses permitted in the base district, including ordinarily permitted uses and uses subject to a conditional use, are subject to a conditional use permit and potential liquefaction hazard analysis in accordance with the procedures set forth in LEMC 17.32.060. Conditions of approval shall include such recommended mitigation measures as deemed appropriate to carry out the intent and purpose of this chapter.

3.11.4 General Plan Update – Goals and Policies

The City of Lake Elsinore General Plan Update addresses Geology and Soils in Chapter 3.0 (Public Safety and Welfare) and in various District Plans. The goals, policies and implementation programs listed in **Table 3.11-3, General Plan Geology and Soils Goals, Policies and Implementation Programs**, apply to geology and soils. The intent of these goals, policies and implementation programs is to minimize the effects of any seismic events on citizens and property.

Table 3.11-3, General Plan Geology and Soils Goals, Policies and Implementation Programs

General Plan Goals, Policies and Implementation Programs
Chapter 2.0 – Community Form (Section 2.3 – Land Use)
Goal 2 Establish and maintain the City as a year-round recreation destination.
Policy 2.3 Consider the feasibility of development of geothermal resources such as a spa or bathhouse establishment in the Downtown area.
Goal 3 Establish a development pattern that preserves aesthetics and enhances the environmental resources of the City.
Policy 3.1 Consider the establishment of hillside grading standards that address unique natural features and encourage the sensitive treatment of hillsides in the site design and architecture of new construction.
Chapter 3.0 - Public Safety and Welfare (Section 3.2 – Air Quality)
Goal 1 Continue to coordinate with the Air Quality Management District and the City's Building Department to reduce the amount of fugitive dust that is emitted into the atmosphere from unpaved areas, parking lots, and construction sites.

GENERAL PLAN GOALS, POLICIES AND IMPLEMENTATION PROGRAMS
Policy 1.1 Continue to implement requirements identified in the National Pollutant Discharge Elimination System (NPDES).
Chapter 3.0 – Public Safety and Welfare (Section 3.6 – Seismic Activity)
Goal 6 Minimize the rise of loss of life, injury, property damage, and economic and social displacement due to seismic and geological hazards resulting from earthquakes and geological constraints.
Policy 6.1 Encourage the pursuit of federal and state programs that assist in the seismic upgrading of buildings to meet building and safety codes.
Policy 6.2 Continue to require Alquist-Priolo and other seismic analyses be conducted for new development to identify the potential for ground shaking, liquefaction, slope failure, seismically induced landslides, expansion and settlement of soils, and other related geologic hazards for areas of new development in accordance with the Fault Rupture Hazard Overlay District adopted by the City of Lake Elsinore Zoning Code. The City may require site-specific remediation measures during permit review that may be implemented to minimize impacts in these areas.
Implementation Program Through project review and the CEQA processes the City shall assess new development and reuse applications for potential hazards, and shall require compliance with Alquist-Priolo and other guidelines where appropriate.
Chapter 4.0 - Resource Protection and Preservation (Section 4.4 – Water Resources)
Policy 4.1 Encourage developers to provide clean water systems that reduce pollutants being discharged into the drainage system to the maximum extent feasible and meet required federal national Pollution Discharge Elimination System (NPDES) standards.
Policy 4.3 Require Best Management Practices through project conditions of approval for development to meet the Federal NPDES permit requirements.

There are no special seismic and geologic hazard policies in any of the District Plans.

3.11.5 SIGNIFICANCE THRESHOLDS

The City of Lake Elsinore has not established local CEQA significance thresholds as described in Section 15064.7 of the State CEQA Guidelines. However, Appendix G of the State CEQA Guidelines indicates that impacts related to geology and soils may be considered potentially significant if the project would:

- 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 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.

- result in substantial soil erosion or loss of topsoil.
- 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.
- be located on expansive soil, as defined in Table18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.
- have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for disposal of waste water.

3.11.6 IMPACT ANALYSIS

METHODOLOGY

The proposed project itself will not directly result in any specific development project. However, individual development projects implemented pursuant to the proposed project could be affected geologic and soil conditions that are known to exist within the area. The impacts upon such individual development projects cannot be fully assessed at this time. As planning progresses for each individual project undertaken within the proposed project's boundaries, potential geologic and soil issues will be considered in light of this PEIR and other relevant federal, State, and local regulations in order to determine whether potentially significant impacts may occur.

Threshold: Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, including liquefaction or landslides.

Threshold: Would the project 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.

Analysis

Project implementation could expose people or structures to potential substantial adverse effects involving seismic hazards, including strong seismic ground shaking and seismic-related ground failure (ground lurching/settlement, and liquefaction/lateral spreading).

Strong Seismic Ground Shaking.

As discussed above, the Project area is located within a seismically active region, with a number of faults traversing or in proximity to the City and one fault traversing the City and SOI itself. As a result, future development in the City and SOI facilitated by the General Plan Update could result in increased population in the area and expose more people or structures to adverse effects involving strong seismic ground shaking. The intensity of ground shaking would depend upon the magnitude of the earthquake, distance to the epicenter, and the geology of the area between the epicenter and the City and its SOI. The possibility of moderate to high ground acceleration or shaking in the City may be considered as approximately similar to the Southern California region, as a whole.

A maximum magnitude earthquake on any of the three major faults (Elsinore, San Jacinto, or San Andreas faults) located in or within proximity of the City could result in significant structural damage or collapse, and potentially human casualties. Unreinforced masonry buildings in and around the City's Historic District are particularly vulnerable. In 2004, the City's Building and Safety Manager[7] stated that the City's Main Street historical downtown area would be particularly vulnerable as many of the buildings in the area were built in the early or mid-20th century, before current, stringent earthquake construction standards were in place. The City has identified 54 commercial buildings on or adjacent to Main Street that were built with un-reinforced masonry. Among the buildings constructed of unreinforced masonry are the Lake Elsinore Cultural Center and parts of City Hall. Like all of southern California, the City and SOI will continue to be subject to ground shaking resulting from activity on regional faults. Increased development throughout the City and SOI in accordance with the proposed project would increase the potential for property loss, injury, or death resulting from this ground-shaking hazard.

Construction subject to City permitting is required to adhere to the minimum standards of the 2010 CBC which includes provisions for construction to resist seismic loading. The City currently requires that owners of 54 at-risk, unreinforced masonry buildings post signs warning of the danger. As such, Policy 6.2 of Chapter 3 (Public Safety and Welfare) of the GPU states the requirement that site-specific studies to evaluate potential for ground shaking, liquefaction, slope failure, seismically-induced landslides, expansion and settlement of soils, and other related geologic hazards for areas for new development in accordance with Chapter 17.28 (Fault Rupture Hazard Overlay Zone) of the City of Lake Elsinore Municipal Code.

Pursuant to the Municipal Code and consistent with the above cited policy of the General Plan Update, the City may require site-specific conditions of approval and remediation measures during permitting and development review that may be implemented to minimize impacts in these areas. Further, the City's General Plan Update Policy 6.1 encourages the development of programs to assist in the seismic upgrading of buildings to meet current Building and Safety Codes.

---

[7] Elsinore Building and Safety Manager Robin Chipman as quoted in North County Time *Downtown Lake Elsinore at Risk in a Quake?*, November 28, 2004. http://www,nctimes.com/new/local/article accessed 5/4/10

Ground Lurching and Settlement.

Since the City of Lake Elsinore and its SOI are located in a seismically active zone and further are sited on top of the Elsinore Groundwater Basin, development within the City could expose people or structures to potential substantial adverse effects involving seismically-induced ground lurching and ground settlement. There is no currently available soil mapping of Lake Elsinore; however, the alluvial and wind-blown deposits on the valley floor may be susceptible to collapse as identified in the Riverside County General Plan. As such, Policy 6.2 of Chapter 3 (Public Safety and Welfare) of the proposed General Plan Update continues the requirement for site-specific studies to evaluate the settlement potential of underlying soils while Chapter 17.,28 and 17.32 of the City Municipal Code, cited above, require those studies and directs City staff and decision makers to impose conditions to mitigate site specific conditions pursuant to the findings and recommendations of site specific geotechnical and soils studies and the requirements of the 2010 California Building Code (CDC).

Liquefaction and Lateral Spreading.

As illustrated on **Figure 3.11-3, Liquefaction Susceptibility in Lake Elsinore Area**, much of the City and SOI located on the Valley floor and foothills is identified as having moderate-to-high liquefaction susceptibility. Therefore, development within those identified portions of the City and its SOI could expose people or structures to potential substantial adverse effects involving liquefaction and lateral spread. Chapters 17.28 and 17.32 of the Lake Elsinore Municipal Code, cited above, require site specific studies for liquefaction potential for projects located in Liquefaction Overlay Zones and Seismic Hazard Overlay zones and the imposition of site- and project-specific conditions as required to mitigate any identified hazard and in accordance with the 2010 CBC.

Landslides.

Landslides and rockfalls can be expected to occur within the City and SOI as a result of seismic activity and other natural processes such as saturation during heavy rains or human activity. Landslides can compromise the integrity of structures and infrastructure existing on slopes and inundate areas below. A substantial portion of the City and SOI is located on slopes of 30 percent or steeper that can potentially cause a significant risk of slope failure. New development under the GPU is planned to occur within steep slope areas. Increased development throughout the City and SOI in accordance with the proposed project would increase the potential for exposure of people or property to significant risk of property loss, injury, or death resulting from slope failure hazards.

The GPU includes Policies 3.1 of the Land Use section of the Community Form chapter and Policy 6.2 of the Seismic Activity section of the Public Safety and Welfare chapter that require the consideration of environmental and geologic features in the planning process, establishment of hillside grading standards, and identification of potential hazards in areas of new development and site-specific remediation if necessary.

Subsidence.

Subsidence can be caused by seismic events, geothermal operations, or the withdrawal of subsurface fluids. The risk of seismic events in the region could result in subsidence risk in the City and SOI. However, geothermal operations are not currently performed in the City and SOI, so risk of subsidence from geothermal operations is low. An assessment of risk of subsidence from withdrawal of subsurface fluids should be evaluated in future studies. New development under the GPU is planned to occur within areas that could have subsidence potential. Increased development throughout the City and SOI in accordance with the proposed project would increase the potential for exposure of people or property to the risk of property loss, injury, or death resulting from subsidence hazards.

The GPU includes Policy 6.2 of the Seismic Activity section of the Public Safety and Welfare chapter that requires identification of potential hazards in areas of new development and site-specific remediation if necessary. In addition, Policy 6.1 encourages programs to assist in seismic upgrading of existing buildings. Further, the LEMC Title 17 (Zoning) Chapters 17.28 and 17.32 cited above establish standards for areas subject to seismic hazard and liquefaction, which address some of the underlying causes of seismically induced subsidence, while Title 15 of the LEMC provides for the application of provisions of the 2010 CBC, which further address mitigation of seismically induced subsidence. Lastly, the EVMWD has established a subsidence monitoring program to identify and monitor those portions of the City that might be susceptible to subsidence as a result of groundwater withdrawal and overdraft.

Geothermal Resources

Geothermal resources, while known to be present in the area, are not currently being utilized for renewable energy production or for tourism-destination development. The GPU recommends that the City study the feasibility of developing and promoting geothermal resources for recreational and tourism activities under Goal 2, Policy 2.3 of the Land Use section of the Community Form chapter. Geothermal resources are not currently being utilized, no designations in the land use plan of the GPU specifically identify geothermal springs or hot spots for industrial or tourism uses, and potential hazards from exposure of people or property to the risk of loss, injury, or death involving geothermal resources do not exist.

Conclusion:

Increased development throughout the City and SOI in accordance with proposed project has the potential to cause impacts involving exposure of people or property to the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, including liquefaction, landslides, lateral spreading, subsidence, or collapse.

However, the City regulates development (and reduces potential seismic impacts) under the requirements of the 2010 California Building Code (CBC) (adopted and modified by the Elsinore Municipal Code Title 15) and project-specific mitigation measures. The potential seismic hazards would be sufficiently mitigated for buildings designed and constructed in conformance with current CBC and industry-accepted engineering standards. Moreover, the General Plan Update proposes, through implementation of Chapter 3, Policy 6.1, to take actions to encourage structural repairs to buildings and structures to meet current Building Code standards related to seismic safety. This action could reduce potential structural damage, particularly of existing, aging structures.

Additionally, future development would be subject to compliance with the provisions of Chapters 17.28 and 17.32 of the City's Zoning Code (Title 17 LEMC) that would reduce seismic hazards to less-than-significant levels. Among other requirements, applicants of future development within the City would be required to prepare geological and geotechnical investigations in areas of potential seismic or geologic hazards, as part of the environmental impact and development review process. Regulatory requirements and GPU goals, policies and implementation programs that would be implemented during the project review process include:

- Continue to require Alquist-Priolo and other seismic analyses be conducted for new development to identify the potential for ground shaking, liquefaction, slope failure, seismically induced landslides, expansion and settlement of soils, and other related geologic hazards for areas of new development in accordance with the Fault Rupture Hazard Overlay District adopted by the City of Lake Elsinore Zoning Code. The City may require site-specific remediation measures during permit review that may be implemented to minimize impacts in these areas. [GPU Public Safety and Welfare Policy 6.3, LEMC Chapter 17.32 and Title 15]

- Through project review and the CEQA processes the City shall assess new development and reuse applications for potential hazards, and shall require compliance with Alquist-Priolo and other guidelines where appropriate. The City shall not approve proposals and projects for development or redevelopment, which do not provide for mitigation of seismic or geologic hazards to the satisfaction of the reviewing departments and agencies. [GPU Public Safety and Welfare Implementation Program, LEMC Chapters 17.28 and 17.32]

- The City shall require preliminary geological investigations of tract sites by State-registered geotechnical engineers and certified engineering geologists (in accordance with the California Building Code). [LEMC Title 15]

District Plans

Seismic hazard impacts would occur throughout the GPU planning area and Ground shaking would affect the planning area as a whole, depending on the underlying soils and distance from the epicenter of any specific seismic event.

However, the City's Municipal Code (Title 17 – Zoning) has special provisions in the form of Hazard Overlay Zones, that recognize and mitigate for the fact that that some portions of the City and its SOI may be more susceptible to specified seismic hazards than others.

The Lakeland Village, Lake View Sphere, Lake Edge, Country Club Heights, and Historic districts have very high susceptibility to liquefaction, with a lower risk in other Districts in the planning area. The GPU includes Policy 6.2 of the Seismic Activity section of the Public Safety and Welfare chapter that requires identification of potential hazards in areas of new development and site-specific remediation if necessary. In addition, Policy 6.1 encourages programs to assist in seismic upgrading of existing buildings. The provisions of the most current CBC and relevant provisions of the LEMC including Title `5 and LEMC Chapter 17.32 would address these issues.

Landslide impacts would be concentrated in districts with steep slopes of more than 30 percent and Hillside Residential land use designations, including the Northwest Sphere, Lake View Sphere, Lakeland Village, Alberhill, North Central Sphere, Meadowbrook, Lake Elsinore Hills, and Riverview districts. District plans for these districts include measures to respect the natural topography of the area and require building practices suitable to the natural environment to reduce landslide risks.

In all cases, every District Plan area is subject to the provisions of the LEMC Title 17 (Zoning) Chapters 17.28 and 17.32 and Title 15, which incorporate the requirements of the 2010 CBC, as well as the provisions of the City's Municipal General Permit (Construction) pursuant to NPDES regulations as discussed in Section 3.9 (Hydrology and Water Quality) and air quality regulations discussed in Section 3.6 (Air Quality) of this PEIR. Accordingly, geologic and seismic impacts occurring in specific Planning Districts would be the same as for the City as a whole and would also be less than significant with mitigation incorporated.

3rd Street Annexation

The 3rd Street Annexation area consists of some hillside development included in the GPU Land Use Plan. Future development within the Annexation area would be required to implement the applicable GPU Goals and Policies, the provisions of the LEMC, and the requirements of the most current CBC to ensure that future development would be compatible with the area's topography and hazard profile. Policies 3.1 and 3.2 of the Land Use section of the Community Form Chapter include the consideration of geologic features in the planning process, establish hillside grading standards to preserve unique features, and encourage hillside site planning solutions. Adherence to these policies would minimize slope failure and other soils and geologic hazards to a less-than significant level with mitigation incorporated.

Mitigation Measures

MM Geology and Soils 1: Individual projects implemented pursuant to the proposed project will be required to demonstrate their avoidance of significant impacts associated with seismic hazards including ground-shaking, liquefaction, landslides, subsidence and collapse through implementation of all goals and policies under the Land Use section of the Community Form Chapter and the Seismic Activity section of the Public Safety and Welfare chapter of the GPU.

MM Geology and Soils 2: The City shall continue to enforce the seismic design provisions for Seismic Zone 4 of the California Building Code, including near-source seismic conditions for all new construction in the City.

Level of Significance

With project-level compliance with the goals, policies and implementation programs of the proposed project, the cited provisions of the Municipal Code, and 2010 CBC requirements, and implementation of mitigation measure MM Geology and Soils 1 and MM Geology and Soils 2, there would be less than significant impacts involving the exposure of people or structures to potential substantial adverse effects involving seismic hazards, including strong seismic ground shaking, ground lurching/settlement, and liquefaction/lateral spreading. Impacts would be reduced to a less than significant with mitigation incorporated level.

Threshold: Would the project result in substantial soil erosion or loss of topsoil.

Analysis

Clearing and grading for construction associated with future development in the City and its SOI could result in short-term soil erosion by wind and water, and loss of topsoil. The potential for soil erosion in any location would be largely determined by the soil type and its susceptibility to erosion, slope, and degree of exposure to weather, especially wind and rain. Erosion of soils that could result in a significant loss of topsoil would largely depend on the location of that development, the properties of underlying soils.

Construction activities for projects implemented pursuant to the Land Use Plan of the General Plan Update could temporarily exacerbate the impacts of soils erosion and wind-blown disturbed soils, resulting in temporary problems of dust control. However, future development would ultimately help reduce erosion impacts to windblown or waterborne, disturbed or uncovered soils, as pavement, roads, buildings, and landscaping are established. Thus erosion-related effects can be minimized through compliance with LEMC provisions that address soil erosion including LEMC Chapter 14.08, Stormwater/Urban Runoff Management and Discharge Controls which requires that development be designed and constructed to provide facilities for the proper conveyance, treatment, and disposal of storm water. Additionally, development sites encompassing an area of one or more acres would require compliance with a National Pollutant Discharge Elimination System (NPDES) permit and consequently the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) including the use of Best Management Practices in compliance with Goal 1 and Policy 1.1 of the Public Safety and Welfare chapter of the GPU and Policies 4.1 and 4.3 of the Resource Protection and Preservation chapter to control erosion and protect surface water and groundwater from the adverse effects of construction activities. Refer to Section 3.9 (Hydrology and Water Quality) of this PEIR for a more detailed discussion of these requirements.

Through compliance with regulatory requirements and implementation of the proposed project's goals, policies and implementation programs potential impacts related to soil erosion or loss of topsoil are considered less than significant.

Mitigation Measures

No mitigation is required.

Level of Significance

Given that future developments would be subject to GPU goals and policies and LEMC standards, as well as NPDES Municipal General Permit requirements for erosion control, grading, and soil remediation, less than significant impacts are anticipated involving soil erosion.

Threshold: Would the project be located on expansive soil, as defined in Table18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

Analysis

Expansive and corrosive soils are widely distributed throughout Riverside County and likely exist within the City and its SOI. Such soil units may be uncovered during project grading activities. If expansive and corrosive soils are not addressed during project construction, substantial damage to foundations and structures can occur over time resulting in significant financial costs. Increased development throughout the City and SOI in accordance with the proposed project would increase the potential for significant exposure of people or property to the risk of property loss, injury, or death resulting from expansive and corrosive soils hazards.

The City regulates development (and reduces potential impacts associated with expansive and corrosive soils) under the requirements of the 2010 CBC and project-specific mitigation measures. The potential impacts associated with expansive and corrosive soils would be sufficiently mitigated for buildings designed and constructed in conformance with current CBC and industry-accepted engineering standards. Additionally, in accordance with Policy 6.2 of the Seismic Activity section of the Public Safety and Welfare chapter of the GPU applicants for future development within the City and its SOI would be required to prepare geological and geotechnical investigations in areas of potential seismic or geologic hazards, as part of the environmental impact and development review process.

Mitigation Measures

MM Geology and Soils 3: Individual projects implemented pursuant to the proposed project will be required to demonstrate their avoidance of significant impacts associated with expansive or corrosive soils through implementation of the policies under the Seismic Activity section of the Public Safety and Welfare chapter.

Level of Significance

With project-level compliance with the goals, policies and implementation programs of the proposed project, the cited provisions of the Municipal Code, and 2010 CBC requirements, and implementation of mitigation measure MM Geology and Soils 3, there would be less than significant impacts involving risks associated with expansive and corrosive soils.

Threshold: Would the project have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for disposal of waste water.

Analysis

In areas that are not currently supported by water or wastewater infrastructure future development would be required to install septic systems or alternative waste water disposal systems. Prior to the installation of such systems, project applicants would be required to comply with applicable City requirements. Future development allowed under the proposed project will be required to comply with the provisions of Chapter 16.24, Chapter 16.34 and Chapter 16.56 of the City's Municipal Code. Therefore the proposed project would not result in the installation of septic tanks or alternative waste water disposal systems in soils incapable of adequately supporting such sewage disposal systems.

Mitigation Measures

No mitigation is required.

Level of Significance

The proposed project would not result in the installation of septic tanks in soils incapable of adequately supporting such sewage disposal systems. Impacts are considered less than significant in this regard.

3.11.7 Level of Significance after Mitigation

With implementation of the policies of the GPU as, previously cited, the applicable provisions of the LEMC, and proposed mitigation measures, potential impacts related to geotechnical hazards, expansive soils, corrosive soils, landslides and subsidence within the City and SOI would be less than significant with mitigation incorporated.

3.11.8 References

In addition to other reference documents, the following references were used in the preparation of this section of the EIR:

City of Lake Elsinore, *General Plan Background Reports*, prepared by Mooney ·Jones & Stokes, January 2006. (Appendix B)

City of Lake Elsinore, *Municipal Code* (Available at www.lake-elsinore.org/index.aspx?page=346; accessed June 20, 2011.)

County of Riverside, *Riverside County General Plan Appendix H, Natural Hazard Mapping, Analysis, and Mitigation: a Technical Background Report in Support of the Safety Element of the New Riverside County 2000 General Plan*, prepared by Earth Consultants International, August 2000. (Available at http://www.rctlma.org/genplan/general_plan_2008/general_plan_2008.aspx; accessed on July 20, 2011.)

County of Riverside, *Riverside County Integrated Project General Plan*, Adopted October 7, 2003. (Available at http://www.rctlma.org/genplan/default.aspx, accessed on July 21, 2011.)

County of Riverside, *Riverside County Integrated Project General Plan, Elsinore Area Plan*, Adopted October 7, 2003. (Available at http://www.rctlma.org/genplan/default.aspx accessed on July 21, 2011.)

County of Riverside, *Riverside County Operational Area Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP)*, March 2005 (Available at www.rvcfire.org/opencms/functions/oes/EmergencyManagement/PlansandPublications; accessed on July 21, 2011.)

Morton, Douglas M., and F. Harold Weber, Jr., 2003, *Preliminary geologic map of the Elsinore 7.5' quadrangle*, Riverside County, California: U.S. Geological Survey Open-File Report 03-281, U.S. Geological Survey, Menlo Park, California. (Available at http://geopubs.wr.usgs.gov/open-file/of03-281/README.pdf; accessed July 21, 2011.)

Southern California Earthquake Data Center, *General Earthquake Information* (Available at http://www.data.scec.org/gen_info.html; accessed July 21, 2011.)

U. S. Department of Agriculture. Soil Conservation Service. *Soil Survey, Western Riverside Area, California,* November 1971. (Available at http://www.soils.usda.gov/survey/online_surveys/california/; accessed on July 20, 2011.)

United States Department of the Interior, *U.S. Geological Survey, Preliminary Geologic Map of the Elsinore Quadrangle, Riverside County, Californ*ia, 2003. (Available at http://geopubs.wr.usgs.gov/open-file/of03-281/els_map.pdf; accessed on July 21, 2011.)

This page intentionally left blank.