5.6 GEOLOGY/SOILS

5.6.1 INTRODUCTION

This section describes the existing geology and soils conditions in the project area, potential environmental impacts, recommended mitigation measures to help reduce or avoid impacts and the level of significance of project impacts after mitigation.

5.6.2 EXISTING CONDITIONS

5.6.2.1 Regional and Local Setting

The project site is within the Transverse Ranges Geomorphic Province, a mountainous region consisting of contiguous, east-west trending mountain ranges and valleys.[1] The East Gateway Project site is located within the Santa Clara River Valley bordered on the south by South Mountain and on the north by Sulphur Mountain-Santa Paula Ridge. The Transverse Ranges are an anomalous east-west trending geological province of deformation associated with relative movement of the North American and Pacific Plates. This portion of the Transverse Ranges is underlain by Tertiary and Quaternary sedimentary and volcanic rocks, and is characterized by east-west trending folds and steeply dipping compressional faults. Young geologic structures characterize the area as a result of the region's active seismicity. Major structural features to the north include the Orcutt fault, the Timber Canyon fault, the Sisar fault, the Cayetano fault, the Santa Paula Ridge Anticline, the Pine Canyon Anticline, the Echo Canyon Anticline, and numerous other onshore and offshore faults[2] (see **Figure 5.6-1, Regional Fault Map**).[3]

5.6.2.2 Project Site Conditions

Physiography and Topography

The East Gateway Project site is approximately 2,500 feet north of the Santa Clara River and is generally bounded by the Santa Clara River floodplain on the south, Haun Creek on the east and south, Santa Paula Creek on the west, and the alluvial fans bordering foothills on the north. The topography of the site is relatively flat or gentle sloping in the south. The project area elevations range from approximately 280 feet above mean sea level (msl) in the south to 310 feet above msl in the north.[4]

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1 California Geological Survey, 2002, Note 36 California Geomorphic Provinces, 4 pages.
2 Dibblee, T.W., 1990, Geologic Map of the Santa Paula Peak Quadrangle, Ventura County, California, Dibblee Geological Foundation.
3 California Geological Survey, 2010 Fault Activity Map of California, 2010, http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html.
4 U. S. Geological Survey, Santa Paula 7.5-minute quadrangle, 1:24,000 scale, 1967.

Surface and Subsurface Geologic Units

The surface geologic units within and near the East Gateway Project site are shown on **Figure 5.6-2, East Gateway Project Area Geologic Map**.[5] Four geologic units are found within the East Gateway Project specific plan and annexation areas. These are from youngest to oldest, wash deposits (map symbol W), young alluvial fan deposits (Qhfy), stream terrace deposits (Qht), and alluvial fan deposits (Qhf). The most common unit is Qhfy young alluvial fan deposits, which underlies all of the annexation area and at least 75 percent of the northern portion of the specific plan area. Wash deposits (W) are along the eastern perimeter of the specific plan area and cross its northeastern and southeastern extensions. Stream terrace deposits (Qht) form a band along the southern edge of the specific plan area.

The four geologic units within the East Gateway Project areas are described as follows:

- Wash deposits (W) are recent deposits in the river channel extending south from Orcutt Canyon and other related tributaries to the north of the East Gateway Project area. These deposits are Holocene/historic in age and composed of unconsolidated silt, sand and gravel. Such materials are generally very loose and generally unsuitable for construction of foundations.

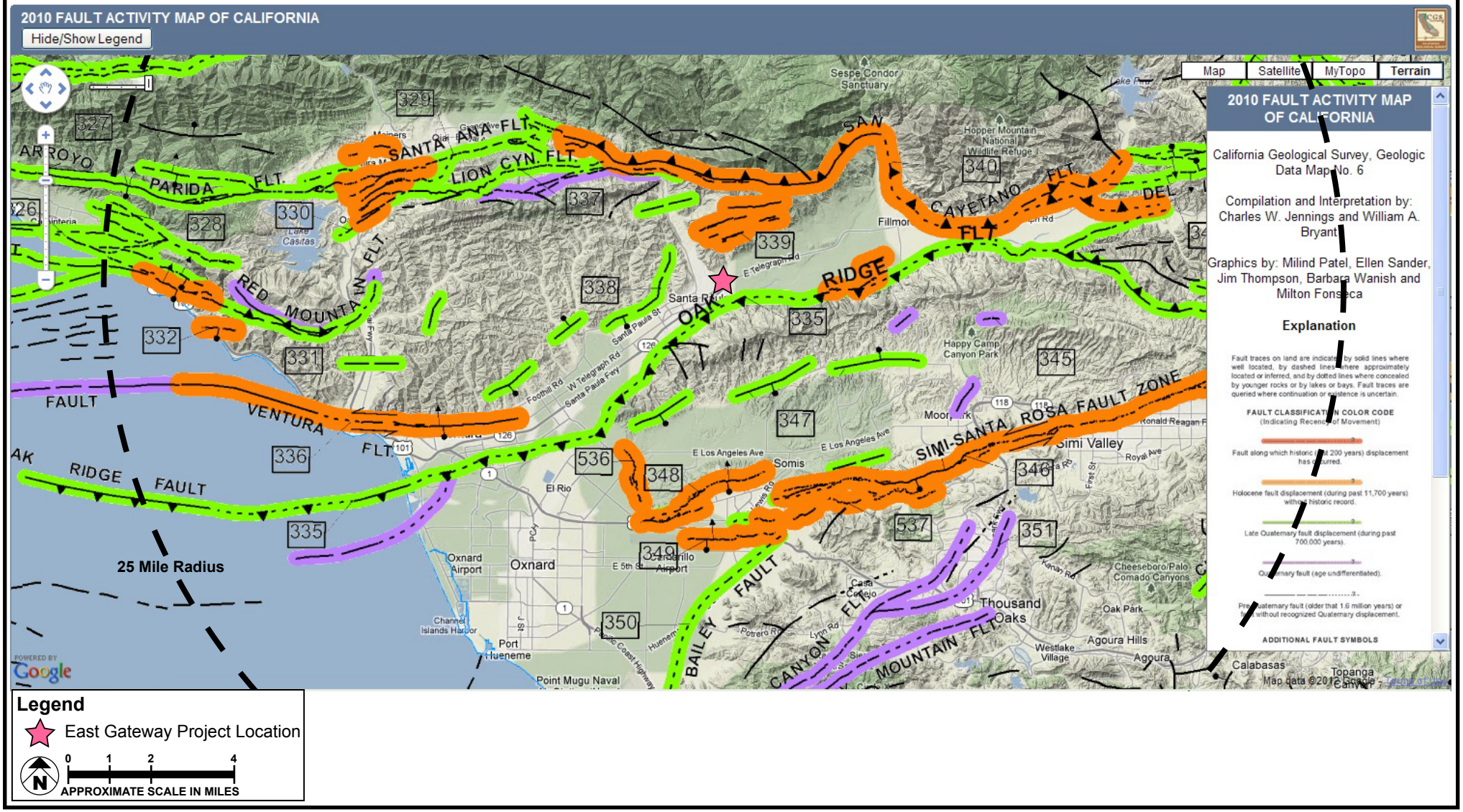
- Alluvial fan deposits (Qhfy) originate from the broad floodplain of Santa Paula Creek on the north and are composed generally of moderately to poorly sorted and bedded gravel, sand, silt, and clay. These deposits are latest Holocene in age as indicated by some historic channels and sand/gravel bars, but are older than the wash deposits that have incised into the Qhfy.

- Stream terrace deposits (Qht) are abundant south of the East Gateway Project area and borders the Santa Clara River. The river has deposited these unconsolidated, poorly sorted, clayey sand and sandy clay with gravel materials in point bars and as overbank sediments during the Holocene.

- Somewhat older Holocene alluvial fan deposits (Qhf) are found in a small portion of the northeast corner of the specific plan area and may underlie the younger fans within the East Gateway Project area. These deposits extend southward from the mountain canyons to the north as debris flows, thick mudflows and braided stream flows. In general, these deposits are moderately to poorly sorted, moderately to poorly-bedded sandy clay with some silt and gravel.

As mentioned, it is possible that older units are buried beneath these younger surface deposits and could be encountered in deep foundations (e.g., early to late Pleistocene alluvial fan [Qf] and alluvial [Qoa] deposits). Softer to harder bedrock formations (e.g., Saugus Formation [Qs] or Sespe Formation [Ts]) are unlikely to be encountered near the ground surface. The East Area 2 project geotechnical study indicates

5 California Geological Survey, Geologic Map of the Santa Paula 7.5' Quadrangle Ventura County, California: A Digital Database Version 1.0 by Siang S. Tan, Kevin B. Clahan, and Pamela J. Irvine Preliminary Geologic Map 2004. available from: http://www.conservation.ca.gov/cgs/rghm/rgm/preliminary_geologic_maps.htm.



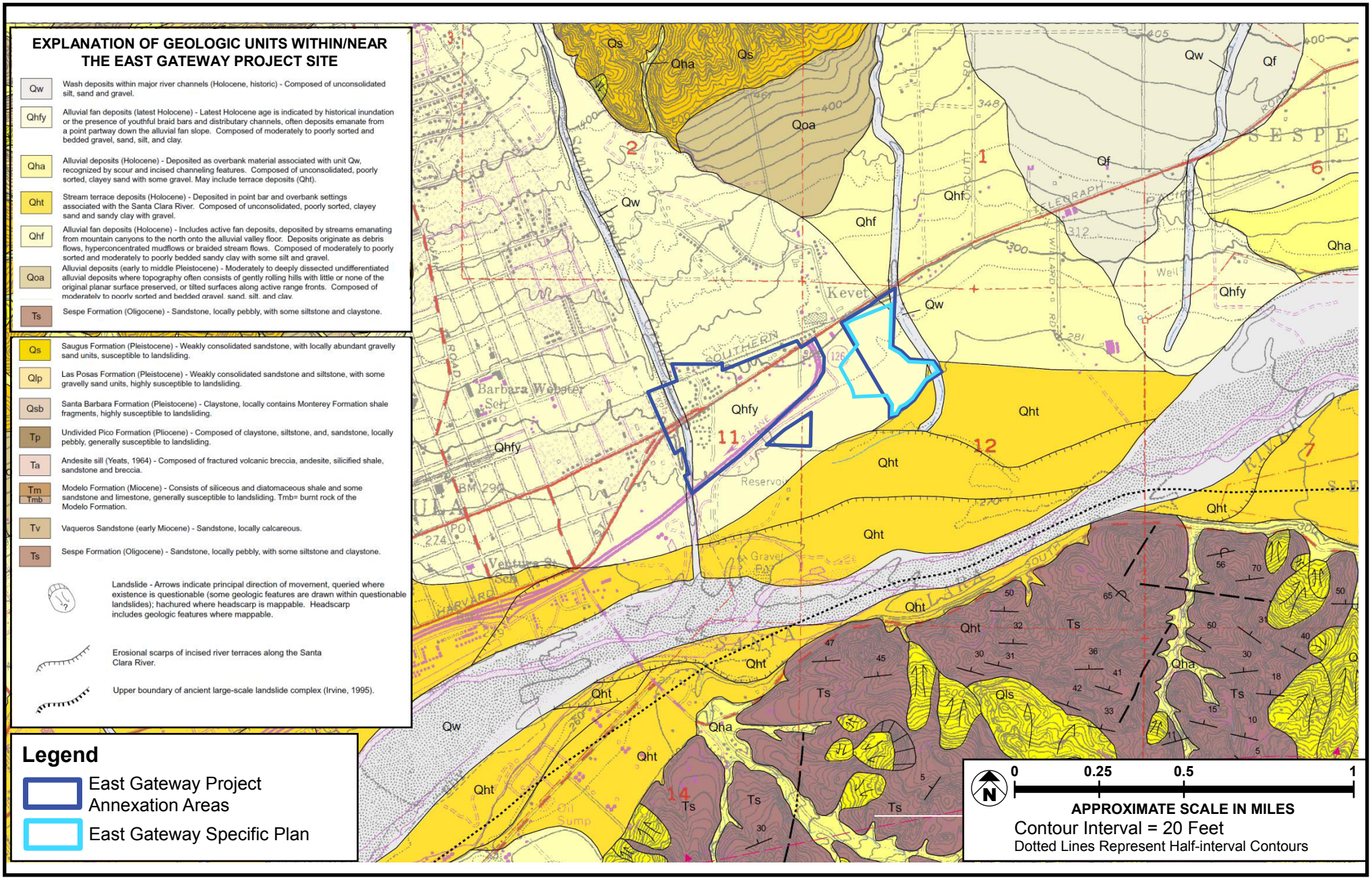
SOURCE: California Geological Survey, 2010

FIGURE **5.6-1**

Meridian Consultants

Regional Fault Map

007-002-12



SOURCE: California Geological Survey, 2004

FIGURE **5.6-2**

Meridian Consultants

East Gateway Project Area Geologic Map

007-002-12

that in areas close to creeks, the thicknesses of the alluvial formations can be 50 feet. Although not shown on available geologic maps, it is likely that non-engineered (uncertified) artificial fill, colluvium, and topsoil materials are present within the East Gateway Project area.

5.6.2.3 Groundwater

The CGS[6] indicates estimated historically shallowest groundwater depths (i.e., historically high groundwater levels) in the Santa Clara River valley (see **Figure 5.6-3, Historically-Shallowest Groundwater Depth Contours**), including the East Gateway Project area. Historically, groundwater beneath the area was as shallow as 20 feet below ground surface (bgs) at the south end of the annexation area and greater than 40 feet bgs at the northern end of the annexation area.[7] Current water levels/depths may vary from these shallowest measurements; however, analysis of potential impacts must consider these very likely more conservative (shallower) values. Borings near the East Gateway Project area indicate that groundwater depth is variable and has been encountered as shallow as 28 feet bgs in some borings while not encountered within 38 feet in others.[8] Locations where geologic units have shallow clay-rich layers (e.g., Qht and Qhf), perched groundwater may be encountered at shallower depths.

It appears that the northeast boundary of the Santa Paula groundwater basin passes through the site trending northwest to southeast (United Water Conservation District [UWCD]).[9] A cluster of four or five groundwater extraction wells lie just south of the specific plan area and two wells lie near the annexation areas. UWCD groundwater contours from spring 2011 indicate groundwater elevations within the East Gateway Project area of approximately 240 to 265 feet (lower to the southwest), suggesting depths of 20 to 40 feet similar to the historically highest levels.[10]

5.6.2.4 Faulting and Seismicity

Faults

On a regional basis, there are many faults within approximately 100 kilometers of the East Gateway Project area that can produce large earthquakes and cause ground rupture along the associated fault

6 California Geological Survey, Seismic Hazard Evaluation of the Santa Paula 7.5-minute quadrangle, Ventura County, California: California Department of Conservation, Division of Mines and Geology Open-File Report 02-61, 2002, Plate 1.2.

7 Ibid.

8 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007.

9 United Water Conservation District, Groundwater and Surface Water Conditions Report – 2011, Open-File Report 2012-02, by the Groundwater Resources Department, May 2012.

10 Ibid, Figure 4.3-11.

plane, damaging buildings, critical structures, utility systems, and transportation facilities. Fault rupture hazards occur along active and potentially active faults due to deep earthquake forces producing movements that reach the ground surface. The APEFZ Act[11] discussed above was passed in 1972 and amended in 1994 to minimize the potential for damage to habitable structures and their occupants. The East Gateway Project site is not located within an APEFZ,[12] although some exist approximately 9,000 feet to the north. None of these APEFZs project toward the East Gateway Project area.

Leighton and Associates [13] identified several active faults located within approximately 25 kilometers of the East Gateway Project site as shown in **Table 5.6-1, Active and Potentially Active Faults within Approximately 25 Miles of the East Gateway Project Area**. The more significant faults are shown on **Figure 5.6-1**.

The characteristics of the known nearby fault systems that are discussed below were gathered from the Southern California Earthquake Data Center[14] and supplemented with information from other sources, where noted.

Oak Ridge Fault

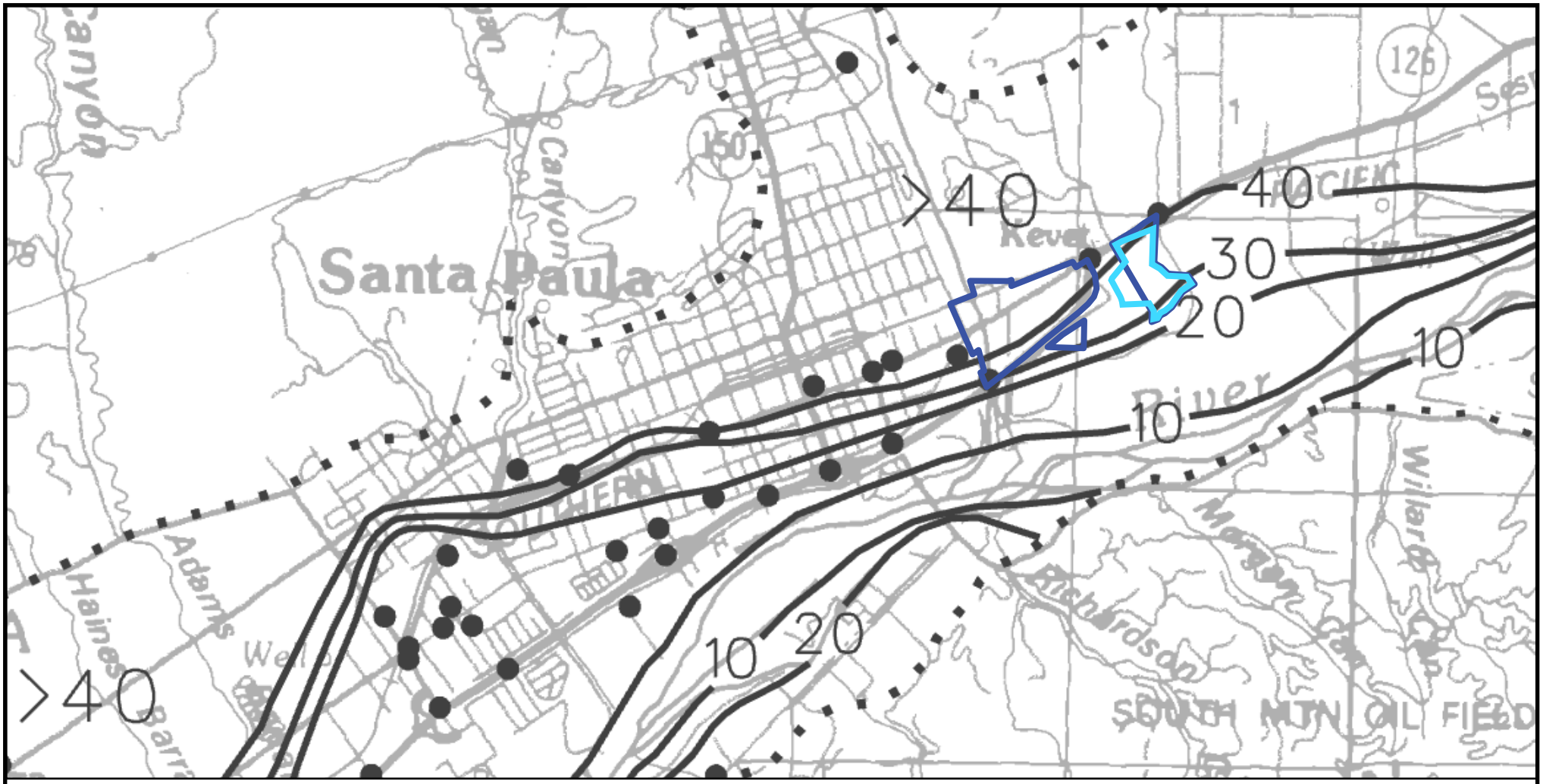
The Oak Ridge fault is a southeast-dipping thrust fault; at its nearest approach, it is located approximately 1,000 feet south of the southern portion of the Site. The Oak Ridge fault is approximately 54 miles long, and is thought to have a slip rate between 3.5 and 6 millimeters per year. The Oak Ridge Fault strikes generally parallel to SR 126 from the unincorporated community of Piru in the east extending out to sea to a point approximately 12 miles due south of Santa Barbara. This fault is expected to produce earthquakes of magnitude (Mw) 6.5 to 7.5.

11 Public Resources Code, Division 2. Geology, Mines and Mining, Chapter 7.5, Earthquake Fault Zoning (Alquist-Priolo Earthquake Fault Zoning Act).

12 California Division of Mines and Geology, 1998, State of California Earthquake Fault Zones Map, Santa Paula 7.5-minute Quadrangle Map, May 1, 1998.

13 Leighton and Associates, Inc., Geologic and Geotechnical Study, East Area 2 Annexation, 95-acres East of the Southern Portion of the City of Santa Paula, Ventura County, California, prepared for Limoneira Company c/o Parkstone Companies, Project Number 031852-001, dated August 26, 2011.

14 The Southern California Earthquake Data Center (SCEDC) is the archive of the Southern California Seismic Network (SCSN). Its primary mission is to distribute data recorded or processed by the SCSN. Website: http://www.data.scec.org/index.html.



Legend

- East Gateway Project Annexation Areas
- East Gateway Specific Plan
- 0 0.25 0.5 1 APPROXIMATE SCALE IN MILES
- Monitoring Well Locations
- Approximate Basin Boundaries
- 20 Historically shallowest ground–water depth contours (in feet)
- >40 Historically shallowest ground–water depth greater than 40 feet over a broad area

SOURCE: California Geological Survey 2002

FIGURE **5.6-3**

Meridian Consultants

Historically-Shallowest Groundwater Depth Contours

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Table 5.6-1
Active and Potentially Active Faults within
Approximately 25 Miles of the East Gateway Project Area

Fault	Maximum Moment Magnitude	Approximate Distance from the Project Site (kilometers)
Oak Ridge (Onshore)	6.9	0.9
San Cayetano	6.8	5.3
Simi-Santa Rosa	6.7	5.5
Ventura – Pitas Point	6.8	5.5
Mission Ridge-Arroyo Parida-Santa Ana	6.7	10.3
Santa Ynez, East	6.7	12.4
Red Mountain	6.8	13.7
Montalvo-Oak Ridge Trend	6.6	15.2
Santa Susana	6.6	15.9
Channel Islands Thrust	7.4	16.7
Oak Ridge (Blind Thrust Offshore)	6.9	17.9
Anacapa-Dume	7.3	18.8
Northridge (East Oak Ridge)	6.9	18.9
Malibu Coast	6.7	21.5
San Gabriel	7.0	23.5

Leighton and Associates, Inc., Geologic and Geotechnical Study, East Area 2 Annexation, 95-acres East of the Southern Portion of the City of Santa Paula, Ventura County, California, prepared for Limoneira Company c/o Parkstone Companies, Project Number 031852-001, dated August 26, 2011.

San Cayetano Fault

The San Cayetano fault is a north dipping thrust fault, located approximately 4.5 miles north of the annexation area. The fault is approximately 27 miles long, and is thought to have a slip rate between 1.3 and 9 millimeters per year. This fault is estimated to be capable of producing earthquakes of magnitude (Mw) 6.5 to 7.3. It may have produced an earthquake on December 21, 1812 that exceeded magnitude 7.0.

Ventura Fault

The Ventura fault is a north-dipping thrust fault, located approximately 12 miles southwest of the annexation area. The fault is approximately 12 miles long, and is thought to have a slip rate of approximately 0.5 to 1.5 millimeters per year. This fault is estimated to be capable of producing earthquakes of magnitude (Mw) 6.0 to 6.8.

Bailey Fault

The Bailey fault is a left-lateral, oblique reverse fault, located approximately 10 miles south of the annexation area. The fault is approximately 12 miles long. The maximum potential earthquake magnitude and the slip rate are unknown. The fault is thought to have last ruptured during the late Quaternary.

Red Mountain Fault

The Red Mountain fault is a north-dipping thrust fault, located approximately 13 miles west of the annexation area. The fault is approximately nine miles long and thought to have a slip rate of 0.4 to 1.5 millimeters per year. This fault is estimated to be capable of producing earthquakes of magnitude (Mw) 6.0 to 6.8.

Simi Fault

The Simi fault is a north dipping fault with a left-lateral reverse sense of slip. It is approximately 17 miles long and, at its closest approach, is approximately 8.5 miles south of the annexation area. Based on studies performed by Hitchcock et al.,[15] the most recent rupture of the fault occurred about 1,350 years before present and produced approximately 6.5 feet to 8 feet of total oblique slip displacement; this is consistent with a magnitude 7 earthquake.

Earthquakes/Seismicity and Ground Motions

The principal factors determining the level of seismic ground shaking risk at a location are (1) the distance to the active and potentially active faults capable of causing a moderate to large earthquake; (2) the maximum and probable earthquake magnitudes for each fault; (3) the recurrence interval (average time between each) earthquake (slip rate); and (4) the type of geologic or man-made materials (e.g., artificial fill, alluvium, or bedrock) underlying the location. Significant ground shaking levels can cause damage to structures, utilities and transportation corridors; cause landslides, rockfalls and embankment failures and induce liquefaction failure in certain cohesionless soils.

Ground shaking is the primary hazard most likely to affect the East Gateway Project area, based upon its proximity to active or potentially active faults. Active or potentially active faults near the project site are listed in **Table 5.6-1,** and shown on **Figure 5.6-1**. These faults are estimated to be capable of generating a peak ground acceleration of greater than 0.10g and a Modified Mercalli Intensity of at least VIII. Although the San Andreas fault is not on the list it is considered in ground shaking estimates due to the

15 Hitchcock, C.S., Lindvall, S.C., Treiman, J.A., Weaver, K.D., Helms, J.G., and Lettis, W.R., 1991, Final Technical Report: Paleoseismic Investigation of the Simi fault, Ventura County, California: United States Geological Survey National Earthquake Hazards Reduction Program, Award Number 99-HQ-GR-0094, dated February 2001.

potential for very large earthquakes and the relatively high probability of occurrence. Other inactive or poorly studied faults may be present within 25 miles of the proposed site; however, the faults listed in **Table 5.6-1** are considered representative of earthquake sources potentially impacting the East Gateway Project area.

Leighton and Associates[16] performed a probabilistic seismic hazard analysis (PSHA) of the East Gateway Project area as shown in **Table 5.6-2, East Gateway Project Area Ground Shaking**.

Table 5.6-2
East Gateway Project Area Ground Shaking

	Design Basis Earthquake (10% in 50 years)		Upper Bound Earthquake (10% in 100 years)	
Attenuation Relationship	**PHGA (g)**	**PHGA (g) (M_W =7.5)**	**PHGA (g)**	**PHGA (g) (M_W = 7.5)**
Boore et al., (1997): 310 m/s	0.85	0.65	1.06	0.82
Campbell (1997, 2000): Alluvium	0.87	0.62	1.04	0.75
Sadigh et al., (1997): Deep Soil	0.92	0.65	1.12	0.80
Average Estimated PHGA	**0.88**	**0.64**	**1.07**	**0.79**

Source: Leighton and Associates, Inc., 2007, Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007; City of Santa Paula, 2007, DEIR for the East Area 1 Specific Plan, Geology and Soils section (http://www.ci.santa-paula.ca.us/eastareaone/Sec4_8-GeologySoils.pdf), November 2007.

The computer program EQSEARCH[17] was used to evaluate past, documented seismic activity near the annexation area. This program performs an automated search of a catalog of historic southern California earthquakes, and computes the distance from a project site to each of the earthquake epicenters within a specified search radius of 62 miles (approximately 100 kilometers). From the computed distances, the program also estimates (using an appropriate attenuation relationship) the peak horizontal ground acceleration that may have occurred at the site due to each earthquake. A database of recorded earthquakes with magnitudes of 4.0 or larger between 1800 and 2011 was used in the analysis.

Leighton and Associates[18] considered ground motions with both a 10 percent probability of exceedance in 50 years (standard construction and an average 475-year return period) and a 10 percent probability of exceedance in 100 years (critical facilities and an 950-year return period). The probabilistic seismic

16 Leighton and Associates, Inc., 2007, Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007.

17 Blake, T.F., 2000, EQSEARCH, Version 3.00, A Computer Program for the Estimation of Peak Horizontal Acceleration from California Historical Earthquake Catalogs, dated April 30, 2000.

18 Leighton and Associates, Inc., 2007, Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007.

hazard analysis (PSHA)[19] considered various magnitudes of earthquakes that major active or potentially active faults within a 100-km radius of the site could produce along their respective fault lengths. The results are believed to be reasonable for the project area due to its immediate proximity to their study area and the very regional nature of the data used. Leighton and Associates agree with the CGS[20] PSHA showing the project area within a range of 0.8g to 0.9g for the 10 percent probability of exceedance in 50 years in alluvium.

Ground motion values were estimated to account for local site soil conditions, in this case alluvium, using the CGS estimation procedures for a "design basis earthquake" and should only be used as planning estimates, not for design [21]. A planning level 10 percent in 50 years estimate of the peak ground accelerations and of the spectral accelerations for 0.2-second and 1.0-second frequencies (short and moderately long periods, respectively) was made for the central portion of the project area (**Table 5.6-3, Estimated Probabilistic Earthquake Ground Acceleration Parameters in the Central Portion of the East Gateway Project Area**). The peak ground acceleration (PGA)[22] value for alluvium agrees with the Leighton and Associates estimates using a previous CBC. The specifics of the seismic design method are explained in the 2010 CBC. Leighton and Associates[23] estimated the peak horizontal ground acceleration (PHGA)[24] for the site using the United States Geological Survey's (USGS) 2008 Interactive Deaggregations utility.[25] The results of this analysis indicate that the predominant modal earthquake has

19 The goal of the probabilistic seismic hazard analysis (PSHA) is to quality the rate (or probability) of exceeding various ground-motion levels at a site given all possible earthquakes.

20 California Geological Survey, 2002, Seismic hazard evaluation of the Santa Paula 7.5-minute quadrangle, Ventura County, California: California Department of Conservation, Division of Mines and Geology Open-File Report 02-61, Plate 1.2.

21 Ibid, 2012, Interactive Probabilistic Seismic Hazard Maps, 2002.

22 Peak ground acceleration (PGA) is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering. Unlike the Richter and moment magnitude scales, it is not a measure of the total energy (magnitude, or size) of an earthquake, but rather of how hard the earth shakes in a given geographic area (the intensity).

23 Leighton and Associates, Inc., 2007, Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, pp. 18-19.

24 Peak Horizontal Ground Acceleration (PHGA) is the most commonly used type of ground acceleration in engineering applications, and is used to set building codes and design hazard risks. In an earthquake, damage to buildings and infrastructure is related more closely to ground motion, rather than the magnitude of the earthquake. For moderate earthquakes, PHGA is the best determinate of damage; in severe earthquakes, damage is more often correlated with peak ground velocity.

25 Leighton and Associates, Inc., Geologic and Geotechnical Study, East Area 2 Annexation, 95-acres East of the Southern Portion of the City of Santa Paula, Ventura County, California, prepared for Limoneira Company c/o Parkstone Companies, Project Number 031852-001, dated August 26, 2011.

Table 5.6-3
Estimated Probabilistic Earthquake Ground Acceleration Parameters in the Central Portion [1] of the East Gateway Project Area

Ground Motion (g)	Firm Rock	Soft Rock	Alluvium
Peak Horizontal Ground Acceleration (g) [2]	0.86	0.86	0.86
Spectral Acceleration [3] (0.2 second period)	1.98	1.98	1.98
Spectral Acceleration (0.1 second period)	0.69	0.78	0.90

Source: CGS, 2012, Interactive Probabilistic Seismic Hazard Maps (2002), 10% Probability of Being Exceeded in 50 Years, CGS website – http://www.consrv.ca.gov/CGS/rghm/psha/pga.htm#PGA.
Notes:
1 - Latitude 34.35916 and longitude -119.04455.
2 - PGA; in "g" force of gravity
3 - Spectral Acceleration = 0.2 second generally represents the natural period for short (1- to 3-story) buildings).

a PHGA of 1.1g with magnitude of approximately 6.8 (MW) at a distance on the order of 2.2 kilometers for the Maximum Considered Earthquake (MCE).[26]

The largest historical earthquake within the 62-mile radius of the project site was the 1952, magnitude 7.7 Arvin-Tehachapi Earthquake that occurred on the White Wolf fault approximately 51 miles to the northeast. It is estimated to have produced a horizontal ground acceleration of 0.1g at the site. A 1904, magnitude 4.6 earthquakes occurred approximately 0.5 mile from the annexation area and resulted in an estimated horizontal ground acceleration of 0.16g within the annexation area, which is the earthquake event believed to have produced the highest estimated horizontal ground acceleration at the site.

5.6.2.5 Secondary Seismic Hazards

Secondary effects of seismic shaking are non-tectonic processes that are directly related to strong seismic shaking. Ground deformation, including fissures, settlement, displacement and loss of bearing strength are expressions of these processes, and are among the leading causes of damage to improvements during moderate to large earthquakes. Secondary effects leading to ground deformation include liquefaction, lateral spreading, settlement, and landsliding.

Liquefaction

Liquefaction-induced ground failure can involve a complex interaction among seismic, geologic, soil, topographic, and groundwater factors. Failures can include ground fissures, sand boils, ground settlement, and loss of bearing strength, buoyancy effects, ground oscillation, flow failure, and complex

26 The "maximum considered earthquake", or "maximum considered event" (MCE) for a specific area, is an earthquake that is expected to occur once in approximately 2,500 years; that is, it has a 2-percent probability of being exceeded in 50 years.

lateral spread landslides.[27] These, in turn, can affect surface and subsurface structures. Lateral spread is a liquefaction-induced landslide of a fairly coherent block of soil and sediment deposits that moves laterally (along the liquefied zone) by gravitational force, sometimes on the order of 10 feet, often toward a topographic low such as a depression or a valley area. The three key factors that indicate whether an area is potentially susceptible to liquefaction are the capacity for severe cyclic ground motions, shallow groundwater, and low-density granular deposits (mainly finer grained sands). In these areas, where alluvium is sufficiently loose and groundwater is sufficiently shallow that strong earthquake shaking could cause sediments to loose bearing capacity, severe settlement of surface facilities and in some cases uplift of buried structures (e.g., large pipelines) could occur.

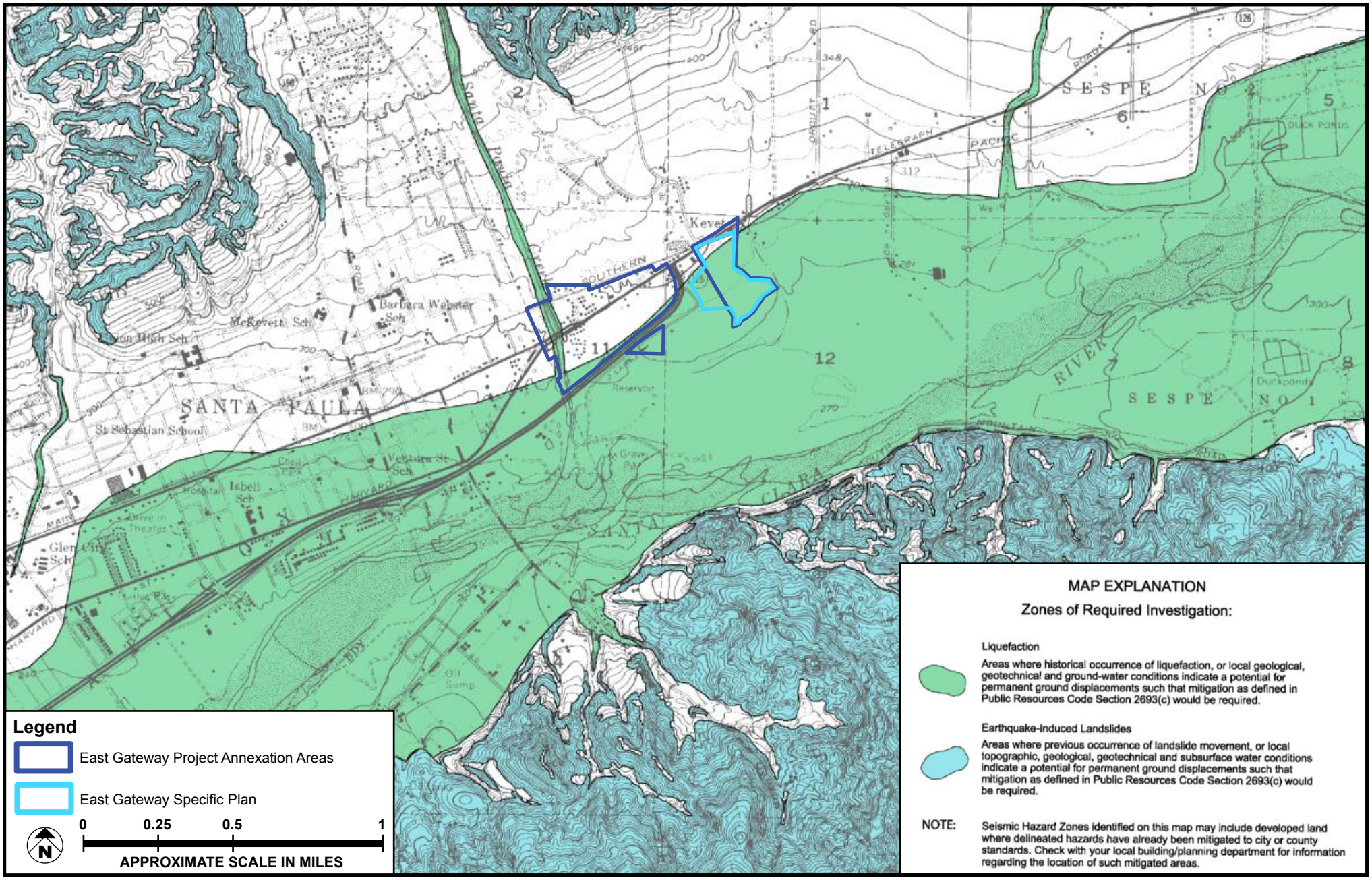
The Seismic Hazard Maps for the Santa Paula quadrangle (**Figure 5.6-4, Liquefaction and Earthquake Induced Landslides**),[28] indicate that portions of the East Gateway Project site are within a State of California zone identified for potential liquefaction hazard. These areas are where historical occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacement such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

As shown, on **Figure 5.6-4**, the majority of the East Gateway Specific Plan area, and portions of the reorganization area (the triangle island) south of SR 126, and a small portion the southern edge of the northern reorganization area north of SR 126 (Lindsay parcel) are within the potential liquefaction area. Because these areas are within the areas that the CGS map show have experienced historical liquefaction, or local geotechnical and groundwater conditions indicate a potential for liquefaction to occur, the potential for liquefaction affecting the Project site is considered to be moderate to high.

Liquefaction-induced lateral spread failures are more prevalent adjacent to topographic depressions or valley areas that form unsupported slopes or “free faces.” The potential for lateral spread landslides are more of a concern in the areas adjacent to the Santa Clara River channel. Such failures have occurred in areas with very low topographic slope gradients. Over approximately 0.75-mile the surface elevation drops about 30 feet toward the river, which is about a one percent slope, crossing two erosional scarps incised into the Qht. Of additional concern in the East Gateway Project area is the Qhfy/Qht interface, which should slope to the south and southwest toward the Santa Clara River.

27 Bartlett, S. F., and T. L. Youd, 1992, Case Histories of Lateral Spreads Caused by the 1964 Alaska Earthquake, in Case Studies of Liquefaction and Lifeline Performance During Past Earthquakes - Volume 2 United States Cases, edited by O’Rourke and Hamada, pages 2-1 through 2-127.

28 California Geological Survey, Seismic Hazard Zone Map — Santa Paula Quadrangle, June 21, 2002, 1:24000.



SOURCE: California Geological Survey, 2002

FIGURE **5.6-4**

Meridian Consultants

Liquefaction and Earthquake-Induced Landslides

007-002-12

The City of Santa Paula General Plan, Safety Element liquefaction map shows the area as completely within a liquefaction zone.[29] Leighton and Associates[30] seismically-induced settlement was not expected to significantly impact the western portion of their site, which is underlain by Qhfy (Holocene young alluvial fan deposits) that cover most of the East Gateway Project area. They indicated that additional subsurface explorations and laboratory testing were required to confirm this general assessment.

Lateral Spreading

Lateral spreading is a phenomenon where large blocks of intact, non-liquefied soil move down-slope on a liquefied substrate of relatively large aerial extent. The mass moves toward an unconfined area, such as a descending slope or stream-cut bluff, or is known to move on slope gradients as gentle as 1 degree. The land in the vicinity of the Site is essentially flat, no slopes are present. As such, the potential for lateral spreading to occur at the site may be low, but this will need to be studied on a case-by-case basis.

Seismically Induced Settlement

Strong ground shaking can cause settlement by allowing sediment particles to become more tightly packed, thereby reducing pore space. Unconsolidated, loosely packed granular alluvial deposits are especially susceptible to this phenomenon. Poorly compacted artificial fills may also experience seismically induced settlement. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement. If settlement occurs, it could result in damage to improvements. There is the potential for seismically induced settlement to occur in areas underlain by alluvial deposits.

Seismically Induced Landslides

Marginally stable slopes may be subject to landsliding caused by seismic shaking. In most cases, this is limited to relatively shallow soil failures on steeper natural slopes, although deep-seated failures of over-steepened slopes are also possible. The annexation area is located on flat land (Figure 1) and thus, the potential for seismically induced landslides is considered to be low.

29 Santa Paula General Plan, Safety Element.

30 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007.

5.6.2.6 Non-Earthquake Geologic and Soils Hazards

Subsidence

Subsidence is the gradual downward settling of the land surface with little or no horizontal movement. It can be caused by many different factors. Extracting large fluid volumes (water, oil, and gas) from thick layers of poorly consolidated sediments is a principal cause of surface subsidence. Since there is a thickness of young, poorly consolidated alluvial sediments in the East Gateway Project area, there is a potential for surface subsidence associated with fluid extraction.

There are no active oil wells on or near the East Gateway Project area. The South Mountain oil field lies as close as a few thousand feet to the south, within consolidated bedrock formations being pumped from 5,000 to 10,000 feet below South Mountain and a portion of the Santa Clara River immediately south of the project area.[31] No reports of surface subsidence were noted.

There are several active water wells just south of the area, which are used for irrigation and potable water.[32] As noted above, dewatering of an aquifer can result in subsidence. Leighton and Associates[33] does not address the issue and UWCD indicates its modeling accounts for subsidence and reports no subsidence in the Santa Paula Basin in its latest district-wide report.

Slope Stability

The annexation area is located on flat terrain, and no significant slopes are present in or immediately surrounding the area. No areas of potential slope instability are shown on the Seismic Hazards Zone Map for the Santa Paula 7.5-Minute Quadrangle, Ventura County, California[34] or the City of Santa Paula General Plan, Safety Element at or adjacent to the site.[35]

Manufactured slopes and walls, if any, from developments within the area should be designed in accordance with current codes and standards, and the design should be reviewed from a geotechnical perspective. When so designed, the risk of slope instability is considered to be very low.

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31 Davis, T. L. and J. S. Namson, Role of Faults in California Oilfields PTTC Field Trip August 19, 2004, Davis and Namson Consulting Geologists, 39 pages.

32 United Water Conservation District, Groundwater and Surface Water Conditions Report – 2011, Open-File Report 2012-02, by the Groundwater Resources Department, May 2012.

33 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007.

34 California Geological Survey, 2002, Seismic Hazard Zones, Santa Paula Quadrangle, Official Map, Released June 21, 2002, Scale of 1 inch = 2,000 feet.

35 Santa Paula General Plan, Safety Element.

Expansive and Consolidation-Prone Soils

Ground surface settlement may occur soils are susceptible to expansion/contraction (very clay-rich soils) and possibly hydroconsolidation (fine-grained granular soils). When present, moderate to high expansion indices indicate that there is a substantial amount of clay in the soils and repeated episodes of wetting and drying will cause distress to structures in contact with such soils. Consolidation (and long-term settlement) is most prominent in clay-rich and silt-rich soils, resulting from loading pressure created by overlying structures, including buildings or artificial fill. This added weight could collapse internal void spaces within the soils, causing overlying structures to settle, and possibly experience damage. This consolidation and settlement can be much more dramatic under severe seismic shaking (dynamic settlement). Hydro-consolidation will also lead to settlement, but includes the addition of water into the soil structure causing more rapid and more substantial settlements.

The following findings are based on review of existing data and our experience in the Santa Paula area.

Compressible and Collapsible Soil

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads, such as from a fill surcharge. Based on our experience in the area, topsoil, and the upper portion of the young alluvial soil are generally expected to be slightly to moderately compressible. Uncontrolled fill would be considered compressible throughout the entire depth.

Collapse potential refers to the potential settlement of the alluvial soil under existing stresses (loads) upon being wetted. The alluvial soil underlying the area is expected to have a slight to moderate collapse potential.[36]

Expansive Soils

The upward pressures induced by expansive soils can have significant effects upon structures and other surface improvements. Shrinkage of these soils during drying can also cause damage as structural support is removed. The alluvial soils present within the site vicinity are expected to exhibit a low expansion potential.[37] Soils with a higher expansion potential (medium or greater) may be encountered locally.

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36 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, p. 14.

37 Ibid. pp. 14-15.

Typical Classification of expansive soil is provided below:[38]

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

Corrosive Soils

Corrosive soils contain chemical constituents that may cause damage to construction materials such as concrete and ferrous metals. One such constituent is water-soluble sulfate, which, if high enough in concentration, can react with and damage concrete. Electrical resistivity, chloride content and pH level are indicators of the soil's tendency to corrode ferrous metals. Based on our experience, the soil in the area is expected to be corrosive to ferrous metals.[39]

Rippability and Oversized Rock

The alluvial soils in the area are expected to be readily excavated using conventional earthmoving methods. Oversized material could be generated depending on the design and specific site conditions and depth of excavation into the alluvial soils.[40]

Suitability as Fill Material

The soils underlying the annexation area are generally suitable for use as compacted fill, provided they are free of debris, significant organic material, and oversized material. Moisture conditioning (either moistening or drying) will generally be needed in order to obtain the proper moisture content needed for compaction.[41]

Slope Instability and Erosion

Slope instability under non-earthquake (static) conditions is considered to be a potentially significant hazard in hillside and artificial cut/fill slope areas. Landslides, mudslides, debris flows, and soil-slips/surficial material failures affect both the area where the material originates and the down slope "run-out" areas where the landslide debris accumulates. Damage to structures can be severe in either location with structures being dislocated from a few to many tens of feet. The East Gateway Project area is in an

38 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, p. 15.

39 Ibid, p. 15.

40 Ibid, pp. 15-16

41 Ibid. p. 16.

area of low topographic slope and is not adjacent to hillside areas where slope failures would be likely emanate. None of the East Gateway Project area is within areas identified by the CGS as requiring investigation to address the potential for seismically-induced landslides.[42]

Erosion is the process by which the earth's surface is worn by wind or water. Susceptibility to erosion is increased in soils and geologic formations that are poorly consolidated, and where topographic relief is high. The unconsolidated alluvial deposits exposed on potential cut slopes or other excavations in the area are expected to be susceptible to erosion.[43] Manufactured slopes composed of compacted fill are also expected to be moderately to highly susceptible to erosion.

The East Gateway Project soils are poorly consolidated (and relatively loose). However, the local topographic relief is low and there are physical barriers (e.g., railroad tracks and SR 126) to overland flow reaching the project area from storm waters up slope on the north. Therefore, erosion potential of on-site soils is considered low.

5.6.3 REGULATORY SETTING

5.6.3.1 State

Building Codes

Development in the State of California is governed by the 2010 California Building Code (CBC; California Building Standards Commission, 2011).[44] These regulations include provisions for site work, demolition, and construction, which include excavation and grading, as well as provisions for foundations, retaining walls, and expansive and compressible soils. Standard residential, commercial, and light industrial construction is governed by the CBC, which the County may amend. The 2010 California Building Code[45] includes additions to the previous building code that make it more stringent, particularly with regard to seismic and earthquake conditions for critical structures such as essential facilities, public schools, and hospitals. The City of Santa Paula has adopted the 2010 CBC as published by the California Building Standards Commission.[46] The 2011 County of Ventura Building Code is based on the 2010 California

42 California Geological Survey, Seismic Hazard Zone Map—Santa Paula Quadrangle, June 21, 2002, 1:24000.
43 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, p. 16.
44 California Building Standards Commission, 2011, 2010 California Building Code, http://www.bsc.ca.gov/default.htm and International Code Council, 2012, Chapters 16 and 16A, Site Class definition.
45 CCR Title 24, Part 2, 2010 California Building Code.
46 Santa Paula Municipal Code, § 150.015 California Building Code, Adopted by Reference. Ordinance 1233.

Building Code, the 2009 International Building Code, and others CBC amendments and building regulations.[47]

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Geologic Hazards Zone Act,[48] renamed the Alquist-Priolo Earthquake Fault Zoning (APEFZ) Act, was enacted to address the hazard and damage caused by surface fault rupture during an earthquake, and defines an active fault as one that has had surface displacements within Holocene time (about the last 11,000 years). Initially, faults were defined in the APEFZ Act as "potentially active," and were zoned, if they showed evidence of surface displacement during Quaternary time (last 1.6 million years).[49] Since 1975, the State of California defined the terms "sufficiently active" and "well defined" for application in zoning faults. These two terms constitute the present criteria used by the State Geologist in determining if a given fault should be zoned under the APEFZ Act, and are defined as follows:

Sufficiently active. A fault is deemed sufficiently active if there is evidence of Holocene surface displacement along one or more of its segments or branches. Holocene surface displacement may be directly observable or inferred; it need not be present everywhere along a fault to qualify that fault for zoning.

Well-defined. A fault is considered well defined if its trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The fault may be identified by direct observation or by indirect methods (e.g., geomorphic evidence). The critical consideration is that the fault, or some part of it, can be located in the field with sufficient precision and confidence to indicate that the required site-specific investigations would meet with some success.

The APEFZ Act requires the State Geologist to establish “earthquake fault zones” (EFZ) along known active faults in the State. Cities and counties that include earthquake fault zones are responsible to regulate most development projects within the EFZ, as described in the APEFZ Act, but may enact regulations that are more stringent. Certain smaller residential developments can be exempt.

48 California Public Resources Code, §§ 2621-2630 as amended
48 California Public Resources Code, §§ 2621-2630 as amended
49 Bryant, W. A. and E.W. Hart, 2007, Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps, California Division of Mines and Geology Special Publication 42.

Seismic Hazards Mapping Act

The Seismic Hazard Mapping Act (SHMA) of 1990[50] was enacted, in part, to address seismic hazards not included in the Alquist-Priolo Act, including strong ground shaking, landslides, and liquefaction. Under the SHMA, the State Geologist is assigned the responsibility of identifying and mapping seismic hazards zones.

The State of California Geologic Survey (CGS) has also adopted seismic design provisions in Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California.[51] The CGS provides guidance with regard to seismic hazards under the SHMA; seismic hazard zones are to be identified and mapped to assist local governments in planning and development purposes. The intent of this publication is to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. Lead agencies with the authority to approve development projects shall ensure the following:

> *"The geotechnical report shall be prepared by a registered civil engineer or certified engineering geologist, having competence in the field of seismic hazard evaluation and mitigation. The geotechnical report shall contain site-specific evaluations of the seismic hazard affecting the project, and shall identify portions of the East Gateway Project site containing seismic hazards. The report shall also identify any known off-site seismic hazards that could adversely affect the site in the event of an earthquake.*
>
> *Prior to approving the project, the lead agency shall independently review the geotechnical report to determine the adequacy of the hazard evaluation and proposed mitigation measures and to determine the requirements of Section 3724(a), above, are satisfied. Such reviews shall be conducted by a certified engineering geologist or registered civil engineer, having competence in the field of seismic hazard evaluation and mitigation."*

The County of Ventura and City of Santa Paula have been mapped pursuant to the SHMA, and there are zones of required investigation for liquefaction and earthquake-induced landslide hazards in and adjacent to the Project Area.

50 California Public Resources Code, Chapter 7.8, §§ 2690-2699.6, Seismic Hazards Mapping Act of 1990.

51 California Geological Survey, 2008, Special Publication 117 Guidelines for Evaluating and Mitigating Seismic Hazards in California.

Natural Hazards Disclosure Act

The Natural Hazards Disclosure Act[52] requires:

"That sellers of real property and their agents provide prospective buyers with a "Natural Hazard Disclosure Statement" when the property being sold lies within one or more state-mapped hazard areas, including a Seismic Hazard Zone." The SHMA specifies two ways in which this disclosure can be made:

c. In all transactions that are subject to Section 1103 of the Civil Code, the disclosure required by subdivision (a) of this section shall be provided by either of the following means:

   1) The Local Option Real Estate Transfer Disclosure Statement as provided in Section 1102.6a of the Civil Code.

   2) The Natural Hazard Disclosure Statement as provided in Section 1103.2 of the Civil Code.

The Local Option Real Estate Disclosure Statement can be substituted for the Natural Hazards Disclosure Statement if it contains substantially the same information and substantially the same warning as the Natural Hazards Disclosure Statement. Both the APEFZ Act and the SHMA require that real estate agents, or sellers of real estate acting without an agent, disclose to prospective buyers that the property is located in an APEFZ or SHMZ (seismic hazard map zones).

California Environmental Quality Act

The California Environmental Quality Act (CEQA)[53] ensures that local agencies consider and review the environmental impacts of projects within their jurisdictions. Environmental documents must consider, and analyze as deemed appropriate, geologic, soils, and seismic hazards. If impacts are considered potentially significant, recommendations for mitigation measures are made to reduce geologic and seismic hazards to less than significant.

52 California Civil Code, § 1103, Natural Hazards Disclosure Act.
53 Public Resources Code, §§ 21000-21177.

5.6.3.2 Local

City of Santa Paula

General Plan

The City of Santa Paula General Plan Safety Element was prepared in 1975 and updated in 1998.[54] The focus of the Safety Element is to adopt policies that will "reduce death, injuries, property damage, and the economic and social dislocation resulting from natural hazards."

As described in the Safety Element, it is the intent of the City to provide for balanced planning decisions based on the recognition of the importance of public safety, and the need to integrate safety concerns with other local issues. Based on the degree of hazard within a given area, the Safety Element is integrated with the other elements when addressing, e.g., land asides (Housing and Conservation and Open Space Elements), decisions on where to locate habitable or critical structures (for hazard avoidance and emergency services), and provision of emergency response in the event of a disaster (Circulation Element).

The Safety Element provides the following goals, objectives and policies that are applicable to the East Gateway Project (Specific Plan and Annexation).

Seismicity/Earthquakes

<u>Goals</u>

Goal 1.1 Development should mitigate undue risks from earthquakes.

<u>Objectives</u>

Objective 1(b)	The City should review and analyze the studies conducted on fault displacement in Santa Paula and Ventura County.
Objective 1 (c)	Information should be reviewed on high intensity ground shaking areas in Santa Paula.
Objective 1(d)	The City should review and document natural and manmade areas that are subject to damage due to ground shaking.
Objective 1(e)	Potential landslide locations should be reviewed and documented.

54 Santa Paula General Plan, Safety Element.

Objective 1(h) Soil conditions should be reviewed to determine if subsidence is a threat.

Policies

The following policies would be followed as applicable to the proposed development and to the seismic hazards determined to be present.

Policy 1.a.a. The City shall require, prior to approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard. If the City finds that no undue hazard of this kind exists, based on information resulting from studies conducted on sites in the immediate vicinity of the project and of similar soil composition to the project site, the geotechnical report may be waived. After the report has been approved or a waiver granted, subsequent geotechnical reports shall not be required, provided that new geological datum, or data, warranting further investigation is not recorded. The City shall submit one copy of each approved geotechnical report, including mitigation measures, if any, that are to be taken, to the State Geologist with 30 days of its approval of the report.

Policy 1.b.b. The City, in preparing the safety element to its general plan pursuant to subdivision (g) of Section 65302 of the Government Code, and in adopting or revising land use planning and permitting ordinances, shall take into account the information provided in available seismic hazard maps.

Policy 1.c.c Establish and update parameters for new construction in identified seismic hazard zones in Title 15 (Buildings and Construction) of the City of Santa Paula Municipal Ordinance.

Policy 1.e.e. Require a geotechnical evaluation, prior to site development, of the potential for displacement along identified active and potentially active faults.

Policy 1.g.g. Require a geotechnical evaluation, prior to site development, of the potential for seismically-induced landslide or liquefaction in areas where such hazards have been identified.

Policy 1.h.h. Develop standards and restrictions such as the limits on the types of allowable development, development intensity/density standards, and subdivision design policies for sites subject to seismically-induced landslides or liquefaction, or potential fault rupture areas for identified active and potentially active faults.

Policy 1.j.j. If evidence of faulting is observed during any subsurface geologic or geotechnical investigation at a site, a special fault investigation shall be initiated following the guidelines in the Alquist-Priolo Earthquake Fault Zoning Act.

Policy 1.k.k. Sites confirmed to be in an area prone to seismically-induced liquefaction shall have foundations designed by a structural engineer.

Policy 1.l.l. Sites confirmed to be in an area prone to seismically-induced landslides shall be graded to increase the factor of safety, or the landslide will be mitigated prior to construction at the site, as determined by a civil or geotechnical engineer.

Geology and Soils

<u>Goals</u>

Goal 2.1 Development should mitigate undue risks from mudslides, landslides, subsidence, radon gas infiltration and other geologic hazards.

Goal 2.2 Existing risks from mudslides, landslides, subsidence, radon gas infiltration and other geologic hazards should be reduced.

Objectives

Objective 2(a) Development should not take place without proper geologic studies and engineering improvements that will mitigate, if not eliminate, the risk of future loss from mudslides, landslides, subsidence, radon gas infiltration and other geologic hazards.

Objective 2(b) Corrective measures should be taken to mitigate or eliminate the risk of loss of life or to existing structures due to geologic hazards.

Policies

The following policies would be followed as applicable to the proposed development and to the geologic and soils hazards determined to be present.

Policy 2.a.a. Require a geotechnical evaluation, prior to site development, of the potential for landslides, mud or debris flows, rock falls, soil settlement or soil expansion in identified hazard areas.

Policy 2.b.b. Develop standards and restrictions such as density/intensity standards for slopes, subdivision design policies, and generalized performance standards for sites subject to landslides, mud or debris flows, rock falls, soil settlement or soil expansion.

Policy 2.c.c. Require a geotechnical evaluation, prior to development, of subsidence potential in areas of known risk.

Policy 2.d.d. Develop standards and restrictions, such as limits on density and restrictions on water wells in areas subject to subsidence.

Policy 2.e.e. Require setbacks and subdivision design within areas subject to other known geologic hazards such as crude oil production and activity

Policy 2.g.g. The civil engineer and project engineering geologist/ geotechnical engineer should coordinate efforts during construction grading at a project site.

Policy 2.h.h.	Hazards caused by project grading which may affect adjacent properties, such as erosion and slope instability, shall be mitigated before final approval of the project is given by the City.
Policy 2.i.i.	Areas identified to be in high expansive soil, or zones of soil settlement, and confirmed through site geotechnical investigations, shall have foundations designed by a structural engineer to withstand the existing conditions, or the site shall be graded under the supervision of a civil engineer.
Policy 2.j.j.	Project sites located at the base of or near the base of, hillside areas should be evaluated for potential exposure to landslides, mud or debris flows, or rock falls.
Policy 2.k.k.	If soil subsidence is observed in a portion of the Santa Clara River Valley within the Santa Paula planning area, the Santa Paula Department of Public Works should initiate an investigation to evaluate the cause for the subsidence, and to develop a program to halt or retard the subsidence.

Santa Paula Municipal Code

The Santa Paula Municipal Code includes the city zoning and development regulations.

The City of Santa Paula has adopted the 2010 CBC as published by the California Building Standards Commission.[55] Additionally, various chapters of the Municipal Code are directly applicable to geology and soils issues including Grading (see Chapter 16.96, Grading Permits and 16.97, Grading Regulation) and Erosion Control see Chapter 16.96, Drainage, Erosion, and Dust Control),[56] and Subdivision Regulations.[57] The City Engineer or Building Official issues grading permits based on the appropriate submittal, including geotechnical and engineering geology reports.

55 Santa Paula Municipal Code, § 150.015 California Building Code, Adopted by Reference. Ordinance 1233, December 20, 2010.

56 Ibid, Chapters 16.96. Grading Permits, 16.97, Grading Regulation, and 16.98, Drainage, Erosion, and Dust Control.

57 Ibid, Subdivision Regulations, Chapter 16.80. Subdivision Regulations.

5.6.4 THRESHOLDS OF SIGNIFICANCE

In order to assist in determining whether a project would have a significant effect on the environment, the *California Environmental Quality Act (CEQA)* identifies criteria for conditions that may be deemed to constitute a substantial or potentially substantial adverse change in physical conditions. Specifically, Appendix G of the *State CEQA Guidelines* (Environmental Checklist Form) lists the following Geology and Soils thresholds, under which a project may be deemed to have a significant impact on the proposed project if it:

- Exposes people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
- Rupture of known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning map issued by the State Geologist from the area or based on other substantial evidence of a known fault:
  - Strong seismic ground shaking.
  - Seismic related ground failure, including liquefaction.
  - Landslides.
- Results in substantial soil erosion or the loss of topsoil.
- Is located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in an off-site landslide, lateral spreading, subsidence liquefaction or collapse.
- Is located on expansive soil as defined in Table 18-1-B of the Uniform Building Code (1994) creating substantial risk to life or property.
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water.

5.6.5 PROJECT IMPACTS

The environmental impact analysis presented below is based on determinations made in the Notice of Preparation (NOP) for issues that were determined to be potentially significant with mitigation incorporated, or for issues identified by reviewing agencies, organizations, or individuals commenting on the NOP that made a reasonable argument that the issue was potentially significant (see Responses to

NOP, **Appendix 1.0**). No issues arose during the NOP process that are not already covered by Appendix G of the *State CEQA Guidelines* (Environmental Checklist Form) for Geology and Soils.

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

a. 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.

Impacts

The proposed East Gateway Project area is not located within an established APEFZ or crossed by a known active fault. The nearest active fault is the Oak Ridge fault is mapped under alluvium approximately 2,500 feet to the south (**Figure 5.6-1**). Southern California Earthquake Center[58] shows the Oak Ridge fault along the north side of the river immediately south of the East Gateway Project area; however, this map is not intended for site-specific analysis and was created for gaining a regional perspective.

No known active faults have been mapped crossing the annexation area and no state of California or City of Santa Paula established in accordance with the APEFZ Act are located within the Project area. As such, the risk of loss, injury or death associated with surface rupture of a known earthquake fault is considered to be very low and is considered to be a less than significant impact.

If the Oak Ridge fault were to be within several hundred feet of the East Gateway Project area and a fault(s) within these zones were to rupture the ground surface during a moderate to large local earthquake, overlying structures (e.g., buildings, utilities, and roads) could be severely damaged and persons could be injured, possibly fatally. In addition to ground rupture, this fault movement could (along with severe ground shaking) cause liquefaction, lateral spread landslides, ground uplift and differential ground deformation, ground tilting, and general ground cracking. Therefore, the potential for surface rupture (and related deformations) as a result of fault plane displacement during the design life of the project could be potentially significant if the buried Oak Ridge fault is in close proximity to the project area.

58 Southern California Earthquake Center, 2012 Historical Earthquakes and Significant Faults Map in Southern California, http://www.data.scec.org/significant/oakridge.html.

Mitigation Measures

The following measures have been identified to mitigate the identified impacts:

5.6-1: Before approval of a tentative map and grading permit for the East Gateway Specific Plan or development within the reorganization (annexation) areas,, the location of any zones of deformation, setback zones, and fault locations for the Oak Ridge fault must be identified by a registered civil engineer or certified engineering geologist, having competence in the field of seismic hazard evaluation and mitigation. If the project engineer or geologist determines that a setback from the mapped zones of deformation is required, it must be plotted on the development plans, and maintained for the project development. Such maps and/or exhibits must be submitted to the City Public Works Director for review and approval.

Residual Impacts

Impacts would be less than significant.

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

b. Strong seismic groundshaking.

Impacts

The proposed specific plan and annexation parcels portions of the East Gateway Project area could be subject to strong ground shaking in the event of an earthquake originating along one of the faults listed in **Table 5.6-1** (or another active or potentially active in the Southern California area; **Figure 5.6-1**). Strong seismic ground shaking potential hazard exists throughout Southern California and could pose a risk to public safety and property by exposing people, property, or infrastructure to potentially adverse effects (e.g., severe structural damage and building collapse).

In addition, being immediately adjacent to an active fault zone (such as the Oak Ridge) can produce very strong ground shaking and amplification (near fault effects) can increase ground shaking levels and effects beyond normal building code design. The predominant modal earthquake has a PHGA of 1.09g

with magnitude of approximately 6.8 (MW) at a distance on the order of 2.2 kilometers for the Maximum Considered Earthquake (2 percent probability of exceedance in 50 years).[59]

Based on the presence of the Oak Ridge fault zone immediately south of the site and the estimated PHGA for the project area, the potential for amplified ground shaking during the design life of the project is significant.

Mitigation Measures

The following measures have been identified to mitigate the identified impacts:

5.6-2: Before approval of a tentative map and grading permit for the East Gateway Specific Plan or development within the reorganization (annexation) areas, a site specific geotechnical report, consistent with the requirements of CGS Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, shall be prepared by a registered civil engineer or certified engineering geologist, having competence in the field of seismic hazard evaluation and mitigation. The geotechnical report shall contain site-specific evaluations of the seismic hazard affecting the project, and shall identify portions of the project site containing seismic hazards. The report shall also identify any known off-site seismic hazards that could adversely affect the site in the event of an earthquake. An earthquake engineering evaluation must be performed to determine if ground motions within the project site would be amplified to an extent where greater than CBC and SPMC design values are required. The report must be submitted to the City Public Works Director for review and approval.

5.6-3 Structures within the East Gateway Specific Plan and development within the reorganization (annexation) areas must be designed in accordance with the 2010 California Building Code (CBC), as adopted by the SPMC, to ensure safety in the event of an earthquake.

Residual Impacts

Impacts would be less than significant.

59 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, pp. 17-18.

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

c. Seismic-related ground failure, including liquefaction.

Impacts

Generally, liquefaction potential is greatest where the ground water level is shallow, and submerged loose, fine sands occur within a depth of about 50 feet or less below the ground surface. Portions of the East Gateway Project, including the East Gateway Specific Plan, southern annexation parcel, and a portion of the northern parcel, are within a liquefaction hazard zone as designated by the State of California and the City of Santa Paula. Historically highest groundwater levels beneath the affected areas are at depths greater than 20 to 40 feet below the existing ground surface.

Historic groundwater data for the Santa Paula area shows that the historic high groundwater levels in the annexation area range from approximately 20 feet below ground surface near the southern boundary to greater than 40 feet below ground surface near the northern boundary.[60] Liquefaction hazard maps prepared by the California Geological Survey and the City of Santa Paula indicate the young alluvial soils in the area may have the potential to be liquefiable, if shallow groundwater conditions were to be present. Therefore, liquefaction is considered to be a potentially significant impact.

Strong ground shaking can cause settlement by allowing sediment particles to become more tightly packed, thereby reducing pore space. Unconsolidated, loosely-packed granular alluvial deposits are especially susceptible to this phenomenon. Poorly compacted artificial fills may also experience seismically induced settlement. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement. If settlement occurs, it could result in damage to improvements. Seismic settlement could occur on the site and is thus considered a potentially significant impact.

Mitigation Measures

The following measures have been identified to mitigate the identified impacts:

5.6-4: Before the approval of tentative maps within the East Gateway Specific Plan and development within the reorganization (annexation) areas, a site specific evaluation must be performed to determine if shallow groundwater is present and if soil/alluvial conditions are conducive to liquefaction, lateral spreading and seismic settlement. Should the site

60 Leighton and Associates, Inc., Preliminary Geotechnical Investigation Report For the East Area 1 Specific Plan Santa Paula Area of Unincorporated Ventura County, California, for the Limoneira Company Project Number 031852-001 April 19, 2007, p. 19.

be susceptible to liquefaction and lateral spreading, a registered civil engineer or certified engineering geologist must provide recommendations for reducing the potential for liquefaction, lateral spreading and seismic settlement. Suitable mitigation alternatives may include one or more of the following:

1. Excavation and removal or recompaction of potentially liquefiable soils;
2. In-situ ground densification (e.g., compaction with vibratory probes, dynamic consolidation, compaction piles, blasting densification, compaction grouting);
3. Other types of ground improvement (e.g., permeation grouting, columnar jet grouting, deep mixing, gravel drains or other drains, surcharge pre-loading, structural fills, dewatering);
4. Deep foundations (e.g., piles, piers), that have been designed to accommodate liquefaction effects;
5. Reinforced shallow foundations (e.g., grade beams, combined footings, reinforced or post-tensioned slabs, rigid raft foundations); and
6. Design of the proposed structures or facilities to withstand predicted ground softening and/or predicted vertical and lateral ground displacements to an acceptable level of risk.

A report documenting the evaluation and design recommendations must be prepared and submitted to the City Public Works Director for review and approval.

Residual Impacts

Impacts would be less than significant.

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

d. Landslides

Impacts

Landslides involve the vertical and lateral movement of large earth masses by gravity (and possible initiated by earthquake forces). If landslides encroach into areas with structures, these structures can be

severely damaged or destroyed, and occupants can be seriously injured if such failures were to occur without some advanced warning (e.g., slope cracking and/or structural deformation).

The Project site is located on essentially flat terrain. No areas of potential slope instability on the site are shown in the Seismic Hazard Zone Report[61] or the City of Santa Paula Safety Element.[62] The topography of the project area is relatively flat and has no landforms where a landslide could form, except for possible lateral spread landslides discussed above. Therefore, the potential for impacts from earthquake-induced landslides or other landslides (except lateral spread landslides) is considered less than significant.

Mitigation Measures

No mitigation is required.

Residual Impacts

Impacts would be less than significant.

5.6.4.2 Result in substantial soil erosion, or the loss of topsoil.

Impacts

The native topsoil and alluvial soils in the Project area may be moderately susceptible to erosion.

Native topsoil and alluvial soils will be particularly prone to erosion during construction or earth moving activities, especially during heavy rains. Fill soils generated during grading and any development may also be subjected to erosion. Construction activity associated with even moderate-scale grading can result in wind, gravity, and water driven erosion of earth materials (soils and geologic units) if soil is disturbed, exposed, or stockpiled. The impact of erosion at the Project site is considered to be potentially significant.

Due to the extent of grading, there could be a substantial loss of topsoil on the proposed East Gateway Specific Plan development area, which would convert what remains of the site agricultural land to urban use, necessitating topsoil removal as part of geotechnical remediation, and/or covering it with roadways, parking areas, and buildings. Therefore, impacts would be significant during construction.

61 California Geological Survey, Seismic Hazard Zone Map — Santa Paula Quadrangle, June 21, 2002, 1:24000.
62 Santa Paula General Plan, Safety Element.

Mitigation Measures

The following measures have been identified to mitigate the identified impacts:

5.6-5 Temporary erosion control measures must be provided during construction. An erosion control plan must be prepared and submitted to the City Public Works Director for review and approval prior to the issuance of grading permits. Erosion control measures may include temporary catchment basins and/or sandbagging to control runoff and contain sediment transport on the Site.

5.6.6 After construction, disturbed areas must be protected until healthy plant growth is established. Typically, protection may be able to be provided by the use of sprayed polymers, straw waddles, jute mesh or by other measures in accordance with the CBC and SPMC.

5.6-7 The applicant at the time of development must comply with conditions under the National Pollutant Discharge Elimination System (NPDES) Permit imposed by the Regional Water Quality Control Board (RWQCB), and to prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) to be implemented during project construction (see **Section 5.9, Hydrology and Water Quality**). The SWPPP Best Management Practices (BMPs) ensure that erosion and sediment transport are minimized to assure that potential off-site runoff and erosion is minimized.

5.6-8 Topsoil in the East Gateway Specific Plan area must be removed and stockpiled for future use as appropriate based on consultation with the City and/or County; specifications for stocking must be developed and noted on the project grading plans, and must be submitted to the City Public Works Director for review and approval prior to the issuance of a grading permit.

5.6-9 Before issuance of a grading permit, site plans must be submitted to the City Public Works Director for review and approval to address long-term erosion control. Project designs must address the potential for erosion and include appropriate protection or paving of exposed ground surfaces, landscaping, providing terraces on slopes, placing berms or V-ditches at the tops of slopes, and installing adequate drainage improvements.

Residual Impacts

Impacts would be less than significant.

5.6.5.3 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; and be located on expansive soil, as defined in the Uniform Building Code (2010), creating substantial risks to life or property.

Impacts

The potential impacts from landslides and liquefaction are discussed in the subsections above.

The alluvial soils present in the annexation area are expected to exhibit a low expansion potential. However, soils with a higher expansion potential (medium or greater) may be encountered locally. Depending on the improvements planned for the area, expansive soils could pose a risk to property. However, as previously noted, geotechnical studies should be conducted to evaluate the potential for expansive soil to impact individual improvements.

Lateral spread landslide potential for the project area is not known; however, it may be present if liquefaction in shallow layers is determined, even with the relatively flat natural slopes toward the Santa Clara River. Without site-specific geotechnical investigations to analyze lateral spread landslide potential in accordance with the 2010 CBC and Special Publication 117,[63] impacts related to lateral spread landslides would be potentially significant.

Quaternary alluvial deposits consisting of silt, sand, and gravel (or larger size) clasts, and possibly clay-rich soils and miscellaneous artificial fill underlie the East Gateway Project area. Within the specific plan development area there are four alluvial geologic units. Without engineering modification the surficial units would be consolidation prone, erodible, and would make poor foundation materials. These conditions could lead to damage for any structures placed over these materials. Expansive soils units may be found in the Qht deposits that could cause damage to foundations and walls due to repeated drying and wetting (shrink and swell). Therefore, geologic, soils, and geotechnical impacts would be potentially significant.

Mitigation Measures

The following measures have been identified to mitigate the identified impacts:

63 California Geological Survey, 2008, Special Publication 117 Guidelines for Evaluating and Mitigating Seismic Hazards in California, http://www.conservation.ca.gov/cgs/shzp/webdocs/Documents/sp117.pdf.

5.6-10: Before issuance of a grading permit for projects within the East Gateway Specific Plan and development within the reorganization (annexation) areas, a geotechnical report must be prepared to provide recommendations for the design of future improvements.

All project elements that require foundations or footings into earth materials must have specific recommendations by a geotechnical engineer as to the suitability of the materials for the intended loads.

The report should provide recommendations for grading and construction of planned improvements to include recommendations for over-excavation of potentially compressible soil, wall design, fill placement, paving, and other geotechnical aspects. Recommendations for grading, planned excavations, slope configuration, foundations, retaining walls, top-of-slope setback distances, toe-of-slope setback distances, and other structure characteristics contained in the report must be adhered to, and/or re-evaluated, as they apply to specific proposed project elements as determined by the City Public Works Director.

The report must be prepared in accordance with CBC and City of Santa Paula requirements. The report must be submitted to the City Public Works Director for review and approval.

5.6-11 Before project approval, site-specific geotechnical and engineering geologic investigations must analyze site-specific lateral spread landslide potential (in accordance with Special Report 117 and the 2010 CBC) and (as appropriate) include provisions for appropriate construction techniques. This must include compliance with CBC design criteria for construction within Seismic Design Category D, E or F. This study and all appropriate recommendations must be prepared by a registered geotechnical engineer and certified engineering geologist, and submitted to the City Public Works Director for review and approval.

Residual Impacts

Impacts would be less than significant.

5.6.5.4 Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

Impacts

Septic tanks would not be used in the proposed project. The project would connect to and use the existing sewage conveyance system. No impact would result.

Mitigation Measures

No mitigation is required.

Residual Impact

No impact would occur.

5.6.6 CUMULATIVE ANALYSIS

Cumulative Impacts

The potential for cumulative impacts associated with geology and soils was assessed, based upon consideration of the proposed project and related projects in the City of Santa Paula. These related projects are identified in **Section 4.0, Cumulative Scenario.**

Geotechnical impacts tend to be site-specific rather than cumulative in nature and any development occurring within the City of Santa Paula would be subject to, at a minimum, uniform site development and construction standards relative to seismic and other geologic conditions that are prevalent within the region. As project development and each related project element would have to be consistent with recommendations contained in each project's future preliminary geotechnical investigation report and be designed in accordance with the California Building Code, cumulative impacts associated with known geologic conditions would be less than significant.

Impacts regarding surficial deposits, namely erosion and sediment deposition, can be cumulative in nature within a watershed. Development of the proposed project site and related projects has the potential to impact areas off-site including water bodies. However, with implementation of a SWPPP, as required by the NPDES permit, cumulative erosion within the watershed would not exceed natural levels, and significant cumulative impacts related to erosion would not occur.

Cumulative Mitigation Measures

No mitigation is required.

Residual Impact

Impacts would be less than significant.

5.6.7 REFERENCES

The local agency planning document used in the preparation of this section is:

- City of Santa Paula, *General Plan*, Safety Element and Technical Appendix V), April 1998.

The following technical report was used in the preparation of this analysis and is provided in **Appendix 5.6**:

- Leighton and Associates, Inc., 2011, Geologic and Geotechnical Study, East Area 2 Annexation, 95-acres East of the Southern Portion of the City of Santa Paula, Ventura County, California, prepared for Limoneira Company c/o Parkstone Companies, Project Number 031852-001, dated August 26, 2011.

5.6.8 METHODOLOGY

5.6.8.1 Utilize Information Developed Adjacent to the Proposed Project Area

A preliminary geotechnical investigation[64] was conducted for the East Area 2 project area. The information developed allowed for characterization of geology and soils conditions for the East Gateway Project annexation parcels and the specific plan area programmatic level of analysis. The geologic and geotechnical study was conducted as follows:

- Available published reports and geologic maps were reviewed and the data analyzed with respect to the annexation area. Historical aerial photographs of the area were also reviewed;

- A site reconnaissance was conducted to observe existing conditions onsite and the general surface distribution of geologic materials; and

64 Leighton and Associates, Inc., Geologic and Geotechnical Study, East Area 2 Annexation, 95-acres East of the Southern Portion of the City of Santa Paula, Ventura County, California, prepared for Limoneira Company c/o Parkstone Companies, Project Number 031852-001, dated August 26, 2011.

- The data obtained from our background review and site reconnaissance was evaluated and analyzed by a Professional Geotechnical Engineer and Certified Engineering Geologist.

5.6.8.2 Utilize Publically Available Geology/Soils Information Pertaining to the Proposed Project Area

The overall approach to geologic, seismic, and soils issues focuses on a) constraints to new development and redevelopment, and b) safety of the development and populations. This requires consideration of existing goals, policies, and implementation procedures to reduce these impacts wherever possible to less than significant levels. For this section we researched, reviewed, and collected readily available geology, seismic and soils information from local, county, state, and federal sources. The resulting information was used to compile data on maps and in tables with sufficient detail to support conclusions regarding development constraints and safety concerns. The applicable City regulations and planning guidelines were confirmed. With this information, we prepared this section to describe the conditions and hazards within the East Gateway Project area, potential impacts, significance thresholds, mitigation measures, and residual and cumulative impacts.