Section 5.7:

Geology and Soils

SECTION 5.7
GEOLOGY AND SOILS

5.7.1 PURPOSE

This section describes the existing geologic, soil, and seismic conditions within the City of Fullerton (City) and identifies potential impacts that could result from implementation of The Fullerton Plan (proposed General Plan Update), and recommends mitigation measures to avoid or lessen impacts. Information in this Section is based in part on the City of Fullerton General Plan Final Environmental Impact Report (June 1994) and the City of Fullerton Local Hazard Mitigation Plan (August 2010).

5.7.2 EXISTING REGULATORY SETTING

Applicable Federal, State, and local regulatory policies and law that apply to geologic, soil, and seismic conditions are discussed below.

FEDERAL

Soil and Water Resources Conservation Act

The purpose of the Soil and Water Resources Conservation Act of 1977 is to protect or restore the functions of the soil on a permanent sustainable basis. Protection and restoration activities include prevention of harmful soil changes, rehabilitation of the soil of contaminated sites and of water contaminated by such sites, and precautions against negative soil impacts. If impacts are made on the soil, disruptions of its natural functions and of its function as an archive of natural and cultural history should be avoided, as far as practicable. In addition, the requirements of the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) through the National Pollution Discharge Elimination System (NPDES) permit) provide guidance for protection of geologic and soil resources.

STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. 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. 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). As indicated in Special Publication 42, the City of Fullerton is not affected by a State-designated Earthquake Fault Zone.[1]

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

The Seismic Hazards Mapping Act (S-H Act) of 1990 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 S-H Act 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 S-H Act 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.

International Building Code

Development standards require projects to comply with appropriate seismic design criteria in the International Building Code (IBC) (with California Amendments), adequate drainage facility design, and preconstruction soils and grading studies. Seismic design standards have been established to reduce many of the structural problems occurring because of major earthquakes. In 1998, the IBC was revised, as follows:

- Upgrade the level of ground motion used in the seismic design of buildings;
- Add site amplification factors based on local soils conditions; and
- Improve the way ground motion is applied in detailed design.

California Building Code

California building standards are published in the California Code of Regulations, Title 24, also known as the California Building Standards Code (CBC). The CBC, which applies to all applications for building permits, consists of 11 parts that contain administrative regulations for the California Building Standards Commission and for all State agencies that implement or

[1] State of California Department of Conservation California Geological Survey, *Special Publication 42 Fault-Rupture Hazard Zones in California Figure 1, Interim Revision 2007*, ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf, Accessed June 27, 2011.

enforce building standards. Local agencies must ensure the development complies with the guidelines contained in the CBC. Cities and counties have the ability to adopt additional building standards beyond the CBC. CBC Part 2, named the *California Building Code* is based upon the 2009 International Building Code, and Part 11, named the California Green Building Standards Code, and is also called the CalGreen Code.

LOCAL

Fullerton Municipal Code

The Fullerton Municipal Code (FMC) includes various chapters that address geology and soils:

- FMC Chapter 2.08 (Disaster Organization and Functions), provides for the preparation and carrying out of plans for the protection of persons and property within the City in the event of a disaster, including earthquakes.

- Chapter 12.18 (Water Quality Ordinance*)*, includes conditions and requirements related to the reduction or elimination of pollutants (including eroded soils) in stormwater runoff from a project site.

- FMC Chapter 14.03 (Building Code), and the California Building Code, 2010 Edition, as adopted by Chapter 14.03, are known as the Fullerton Building Code (FBC). The FBC and CBC include all regulations for how buildings are designed and constructed, and are intended to ensure the maximum structural integrity and safety of private and public buildings. As permitted by Title 24, the City has adopted the following amendments to the CBC (among others) in consideration of the City's location, geology, and vulnerability to natural disasters such as earthquakes:

  - FMC Section 14.03.170 (Amendment to Appendix J, Section J109.4 [Erosion Control Devices])*:* This section specifies the requirements relative to temporary and permanent desilting catch basins, drainage, surfacing, slope planting, and other erosion, surface water, and flood control protective devices.

  - FMC Section 14.03.190 (Amendment to Appendix J, Section J110 [Erosion Control]): All fill and cut slopes in designated hillside areas which are determined by the Building Official to be subject to erosion shall be planted and irrigated with an irrigation system to promote the growth of ground cover plants to protect the slopes against erosion, as required in this section. Where deemed necessary by the Building Official, check dams, cribbing, riprap or other methods and devices shall be installed to control erosion and to promote slope stability.

  - FMC Section 14.03.200 (Amendment to Appendix J, Section J103.1 [Permits Required]): All grading in excess of 250 cubic yards shall be performed in accordance with the approved grading plan prepared by a civil engineer and shall be designated as "engineered grading."

5.7.3 EXISTING ENVIRONMENTAL SETTING

This section identifies existing earth resources, and seismic and geologic hazards within the City. Earth resources in this context include geologic and soil conditions.

GEOLOGY

Regional Conditions

Orange County is a geographically diverse area of mountains, hills, flatlands, and shoreline. Fullerton is located in the northwest portion of Orange County, northwest of the Santa Ana Mountains. The City is located along the fringe of the coastal plain of Los Angeles County and Orange County. Specifically, Fullerton is located within the central lowland coastal plain of Orange County, which stretches northeasterly from the vicinity of Irvine, past Santa Ana and Garden Grove, and into Los Angeles County.

The coastal plain of Los Angeles County and Orange County is bounded by the Santa Ana Mountains, and the areas of Elysian, Repetto, and Puente Hills to the northeast; the Santa Ana Mountains to the southeast; the San Joaquin Hills to the south; and the Pacific Ocean on the west. The primary rivers traversing this coastal plain include the Rio Hondo, San Gabriel, Los Angeles, and Santa Ana rivers, none of which traverse the City. The Rio Hondo River flows in a southwest direction across the coastal plain and merges with the Los Angeles River. The San Gabriel River flows south on the eastern portion of the coastal plain generally parallel to the Los Angeles River. The Santa Ana River originates in the San Bernardino Mountains and traverses through San Bernardino, Riverside, and Orange counties.

The coastal plain of Los Angeles County and Orange County was formed from recent (Holocene) alluvial deposits. The alluvial fans of the Los Angeles, San Gabriel, Rio Hondo, and Santa Ana rivers resulted from the formation of a gently sloping plain through stream deposition. The portion of the coastal plain within Orange County is underlain by deep structural depression primarily containing sedimentary rocks. The subsurface of the County varies in thickness and lithology due to the rapid rate of deposition of rock units, folding, and faulting. The sedimentary deposits of the coastal plain are a hybrid of marine and continental sediment. A significant amount of the sedimentary deposits have been removed over time due to erosion.

Local Conditions

Topographically, Fullerton is divided into two distinct geographical areas. The southerly portion of the City consists of primarily flat, planer types of areas with a gradual slope to the south and west. The northerly part of the City consists of gently rising foothills.

Fullerton is located within the central block of the Los Angeles basin. There are three natural geologic-geographic divisions of the basin represented in the City: the central plain; Coyote Hills; and a small area north of Coyote Hills. The central plain, which extends from the south City limits northerly to the south edge of Coyote Hills, makes up approximately one-half of the City. The Coyote Hills, which cover the northern portion of Fullerton, also makes up approximately one-half of the City.

Most of the geologic structures in the City trend roughly east to west. The major groups of geologic strata in the Fullerton area consist of Basement Complex schist, which underlies the Puente Hills at depth; over this basement rock is the Puente Formation, which is a series of shales and sandstone of Miocene Age (approximately 15 million years old). South of the Whittier Fault, the Puente Formation is present at great depth, below the Fernando Formation. The Fernando Formation consists of beds of sandstone and silty sandstone of Pliocene-Age (age range of 3 to 12 million years old). Overlying the Fernando is the Quaternary group consisting of the San Pedro, Coyote Hills, and La Habra formations, with alluvium on top. The Quaternary group represents the last three million years on the geologic time scale. These formations consist of sandstone, siltstone, and conglomerate beds that are not strongly jointed together.

Fullerton is underlain by three formations: surficial formations; terrace deposits; and alluvium. The surficial and terrace deposits are interspersed in the northern portion of the City. Alluvium underlays the southern portion of the City, those areas south of Chapman/ Malvern Avenue.

The West Coyote Hills are located in the northeastern part of the Los Angeles basin and are part of a chain of low hills extending from Yorba Linda on the east to Santa Fe Springs on the west. These hills are geologically young features that are still in the process of forming under regional tectonic stresses. Most of the uplifted areas have been oil bearing to various degrees.

West Coyote is an asymmetrical, dome-shaped hill, with a steep north flank and more gently-sloping south flank. The south flank of the hills is incised by numerous ephemeral streams which drain into catchment structures along the south. Slope gradients on the south flank range from approximately 10 to 20 percent, with slope gradients as steep as 100 percent on canyon walls. Several “notches” are evident in ridges and side slopes, which are interpreted to be remnants of past stream cutting or filling activity that occurred as the hills were uplifted. Elevations range from approximately 300 feet above sea level at the southern boundary to 600 feet at the crest of the hill on the north.

The natural topography has been altered significantly over the years by oil field activities. These alterations generally consist of graded roads, well pads, canyon fills, and steep cuts into natural slopes.

SOILS

Fullerton is urbanized and primarily built out. Surface soils in the City may no longer reflect the natural soil associations and characteristics identified below since topsoil in the City has been predominately developed. Fill material of unknown origin and varying composition currently occurs over most of the developed area of the City.

Soil Associations

A soil association is an overarching classification of similar soil types occurring on similar material or on a combination of rocks and soil types that have similar profiles, arrangements, sequence of layers, or other characteristics. According to the United States Department of Agriculture Soil Conservation Service General Soil Map, Orange and Western Part of Riverside Counties, the following soil associations underlie Fullerton:

- ***Metz-San Emigdio Association.*** The Metz-San Emigdio association is characterized by nearly level, somewhat excessively drained and well drained, calcareous loamy sands and fine sandy loams on alluvial fans and flood plains.

- ***Sorrento-Mocho Association.*** The Sorrento-Mocho association is characterized by nearly level to moderately sloping, well drained sandy loams, loams, and clay loams on alluvial fans and flood plains.

- ***Myford Association.*** The Myford association is characterized by nearly moderately steep, moderately well drained sandy loams that have strongly developed subsoil, on terraces.

- ***Alo-Bosanko Association.*** The Alo-Bosanko association is characterized by strong sloping to steep, well drained clays on coastal foothills.

Soil Types and Characteristics

According to the United States Department of Agriculture Soil Conservation Service and Forest Service *Soil Survey of Orange County and Western Part of Riverside County, California*, soil types and characteristics within Fullerton include the following:

- ***Alo clay, 9 to 15 percent slopes.*** This strongly sloping[2] soil generally occurs on ridges and toe slopes in the foothills. If the soil is bare, runoff is medium and the erosion hazard is moderate. The soil has an available water capacity of 3.5 to 7.0 inches.[3]

- ***Alo clay, 15 to 30 percent slopes.*** This moderately steep soil generally occurs on broad ridgetops in the foothills. If the soil is bare, runoff is rapid and the erosion hazard is high. The soil has an available water capacity of 3.5 to 6.0 inches.

- ***Cieneba sandy loam, 30 to 75 percent slopes.*** This steep to very steep eroded soil generally occurs on or near ridgetops. In many places it is cut by gullies and intermittent drainage channels. Geologic erosion is active, and small landslips are common. If the soil is bare, runoff is rapid and the erosion hazard is high. The soil has an available water capacity of 0.75 to 2.5 inches.

- ***Corralitos, loamy sand.*** This nearly level to gently sloping soil generally occurs as long narrow areas along stream channels. If the soil is bare, runoff is slow and the erosion hazard is slight. The soil has an available water capacity of 4.0 to 5.5 inches.

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[2] The Slope Classes used in the Soil Survey are: Nearly level (0 to 2 percent); Gently to moderately sloping (2 to 9 percent); Strongly sloping (9 to 15 percent); Moderately steep (15 to 30 percent); Steep (30 to 50 percent); and Very steep (50 to 75 percent).

[3] Available Water (Moisture) Capacity is defined as the capacity of soils to hold water available for use by most plants. The capacity (in inches) in a 60-inch profile or to a limiting layer is expressed as Very Low (0 to 3 inches); Low (3 to 6 inches); Moderate (6 to 9 inches); and High (greater than 9 inches).

- ***Metz loamy sand.*** This nearly level to gently sloping soil generally occurs on large fans and on flood plains. If the soil is bare, runoff is slow and the erosion hazard is slight. The soil has an available water capacity of 4.0 to 6.0 inches.

- ***Metz loamy sand, moderate fine substratum.*** This nearly level to gently sloping soil generally occurs on large fans and on flood plains. If the soil is bare, runoff is slow and the erosion hazard is slight. The soil has an available water capacity of 4.0 to 6.0 inches.

- ***Mocho Loam, 0 to 2 percent slopes.*** This nearly level soil generally occurs on fans or flood plains. If the soil is bare, runoff is slow and the erosion hazard is slight. The soil has an available water capacity of 9.5 to 12.0 inches.

- ***Myford sandy loam, 2 to 9 percent slopes.*** This gently sloping to moderately sloping soil generally occurs on broad terraces. If the soil is bare, runoff is medium and the erosion hazard is moderate. The soil has an available water capacity of 2.0 to 4.0 inches.

- ***Myford sandy loam, 9 to 15 percent slopes.*** This strongly sloping soil generally occurs on side slopes of terraces. If the soil is bare, runoff is medium to rapid and the erosion hazard is moderate to high. The soil has an available water capacity of 2.0 to 4.0 inches.

- ***Myford sandy loam, 15 to 30 percent slopes.*** This moderately steep soil generally occurs on side slopes of terraces. If the soil is bare, runoff is rapid and the erosion hazard is high. The soil has an available water capacity of 2.0 to 4.0 inches.

- ***Myford sandy loam, 9 to 30 percent slopes, eroded.*** This strongly sloping to moderately steep shallow soil generally occurs on side slopes of terraces. If the soil is bare, runoff is rapid and the erosion hazard is high. The soil has an available water capacity of 1.5 to 3.5 inches.

- ***Rincon clay loam, 2 to 9 percent slopes.*** This gently sloping soil generally occurs on broad terraces. If the soil is bare, runoff is medium and the erosion hazard is moderate.

- ***Rincon clay loam, 9 to 15 percent slopes.*** This strongly sloping soil generally occurs on terraces. If the soil is bare, runoff is medium and the erosion hazard is moderate.

- ***San Emigdio fine sandy loam, 0 to 2 percent slopes.*** This nearly level soil generally occupies alluvial fans on flood plains and along stream channels. If the soil is bare, runoff is slow and the erosion hazard is slight. The soil has an available water capacity of 7.0 to 9.0 inches.

- ***Xerorthents loamy, cut and fill areas, 15 to 30 percent slopes.*** The slope of these areas was determined from the undisturbed landscape. Present land use is primarily single-family homes. Runoff is rapid, and the erosion hazard is high.

SEISMICITY AND FAULTING

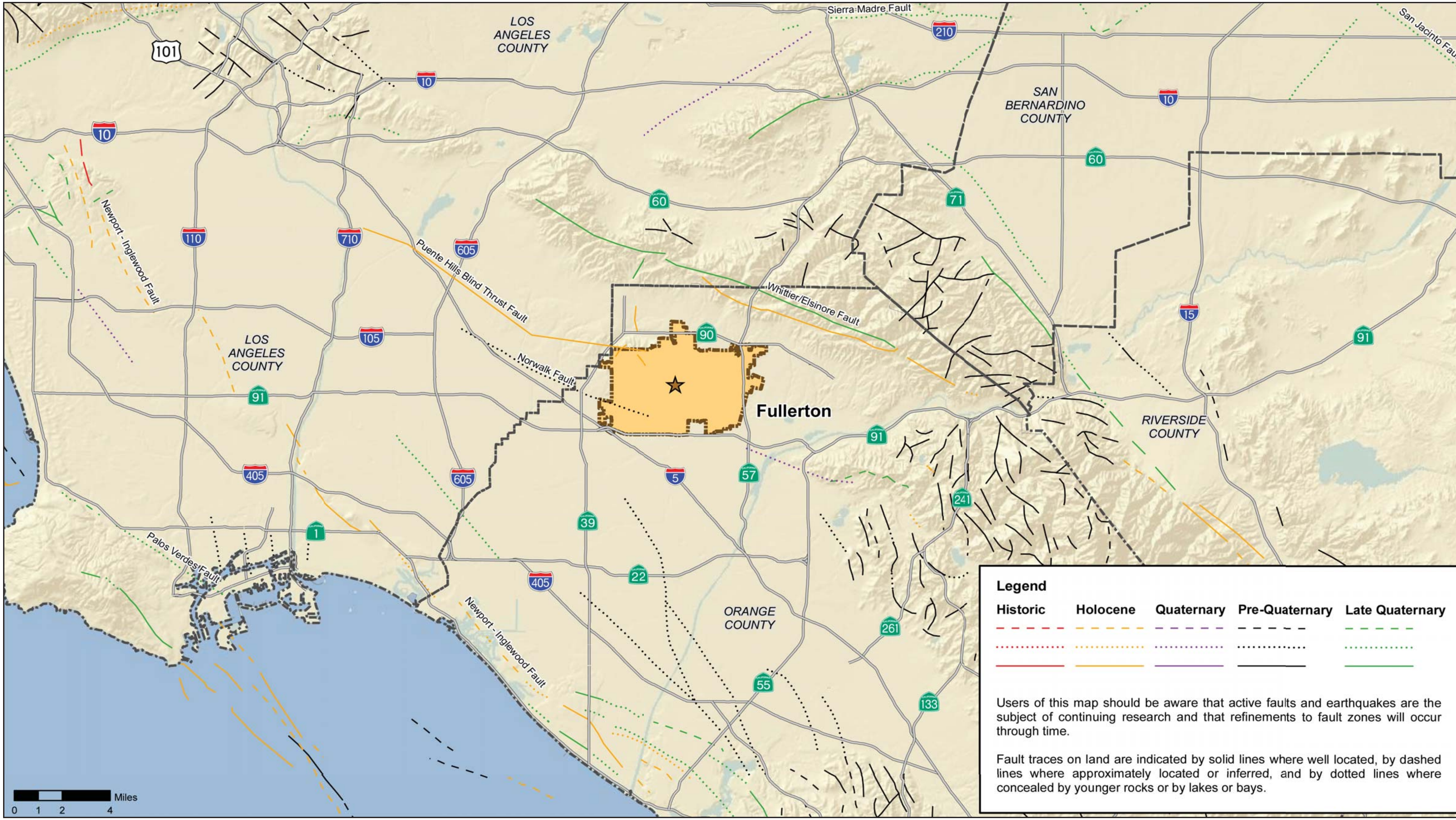
Seismic Characteristics and Faults

A fault is defined as a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side. Most faults are the result of repeated displacement that may have taken place suddenly and/or by slow creep. A fault zone is a zone of related faults that commonly are braided and subparallel, but may be branching and divergent. An active fault is defined by the State Mining and Geology Board as one which has had surface displacement within Holocene time (approximately the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time), but is not proven by direct evidence to have moved or not moved within the Holocene, is considered to be potentially active. Any fault older than Pleistocene (1.8 million years) is considered inactive.

The City of Fullerton, similar to the rest of California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. The local and regional faults that have the potential to affect the City are depicted on Exhibit 5.7-1, *Regional Faults*, and further described in Table 5.7-1, *Descriptions of Regional Faults*. Two faults, the Norwalk Fault and Puente Hills Fault, traverse Fullerton. As previously noted, the City of Fullerton is not listed within a State designated Alquist-Priolo Earthquake Fault Zone. The Whittier-Elsinore Fault and Newport-Inglewood Fault are located within ten miles of the City. Faults that have the potential to affect the City are further discussed below.

Norwalk Fault. The Norwalk Fault traverses the central and southeastern portion of Fullerton. This fault extends approximately 17 miles from Norwalk to Coyote Hills. West of the Coyote Hills, the evidence of the fault's existence becomes vague. It is doubtful the fault extends west of the San Gabriel River. East of the Coyote Hills, the fault may trend along the base of the East Coyote Hills and bend northeasterly, trending near the intersection of State College Boulevard and Yorba Linda Boulevard, and then continuing northeasterly through the vicinity of Carbon Canyon Dam to join the Whittier Fault, north of the dam. The fault is noted as the possible source of a magnitude 4.7 earthquake occurring on July 8, 1929, which caused significant damage in Whittier and Norwalk. Microseismic activity along the Norwalk Fault is high; the fault may be capable of generating a magnitude 6.3 earthquake on the Richter scale. The Norwalk Fault is one of two faults located within the City; however no surface faulting has been associated with this fault.

Puente Hills Fault. Within Fullerton, the Puente Hills Fault, or Puente Hills thrust system, underlies the East and West Coyote Hills, located in the northern and western portions of the City. The Coyote Hills were most likely created by repeated Puente Hills earthquakes as the rupture includes the Coyote Hills fault. The fault is often referred to as a "blind thrust fault" due to lack of superficial ground features normally associated with thrust faults that have recently experienced seismic activity. The Puente Hills Fault comprises three distinct fault segments: the Los Angeles, Santa Fe Springs, and Coyote Hills segments, from west to east, respectively.



Source: Fault lines were obtained from the California Geological Survey, the USGS online database and the NASA.

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THE FULLERTON PLAN 2030
PROGRAM ENVIRONMENTAL IMPACT REPORT

Regional Faults

Exhibit 5.7-1

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Table 5.7-1
Descriptions of Regional Faults

Fault Name	Location/Distance from City to Fault (miles)	Length of Fault (miles)	Richter Magnitude of Historical Earthquakes (Greater than 5.0)	Potential Probable Earthquake Magnitude
Norwalk Fault	0 miles	17	4.70 (1929)[1]	6.3
Puente Hills	0 miles	25 [2]	7.2 to 7.5 (over past 11,000 years) [3]	6.65 to 7.45 [4]
Whittier-Elsinore Fault	1.6 miles northeast	135-145	6.00 (1910) 5.00 (1920) 5.10 (1940) 5.90 (1987)	6.0 to 7.2 for the Whittier Fault segment 6.5 to 7.5 for the Elsinore Fault segment
Newport-Inglewood	9.8 miles southwest	50-86	6.30 (1933) 5.40 (1941)	6.0 to 7.2 or greater
Sierra Madre/ San Fernando/ Santa Susana	14 miles north	61-69	6.40 (1971) 5.80 (1971) 5.80 (1991)	6.0 to 7.0
Palos Verdes Hills	20 miles southwest	45	5.40 (1941)	6.0 to 7.0 or greater
San Jacinto	36 miles east	130-242	7.00 (1899) 6.80 (1981) 6.00 (1937) 6.20 (1954) 6.40 (1958) 6.50 (1968) 5.50 (1980) 6.10 (1980) 6.40 (1987)	6.5 to 7.5
San Andreas	37 northeast	300-320	8.00 (1857) 6.50 (1948) 5.60 (1986)	6.8 to 8.0

1 Southern California Earthquake Data Center, supported by the U.S. Geological Survey, Seismological Laboratory, California Institute of Technology, and SCEC, http://www.data.scec.org/fault_index/alphadex.html, accessed October 2009.
2 *Science, Recognition of Paleoearthquakes on the Puente Hills Blind Thrust Fault, California* article, Volume 300, Issue 4, April 2003.
3 *Earthquake Spectra, Loss Estimates for a Puente Hills Blind-Thrust Earthquake in Los Angeles, California,* Article, Volume 21, No. 2. Earthquake Engineering Research Institute, May 2005.
4 *Revised Draft Environmental Impact Report, Volume 1 (SCH NO. 1997051056), West Coyote Hills Specific Plan and Robert E. Ward Nature Preserve* Memo, prepared by Dr. Edward (Ned) H. Field, United States Department of the Interior, May 22, 2006.

The fault dips gently northeastward and terminates upward at a depth of approximately 2 miles, extending for 25 to 30 miles from northern Orange County, beneath downtown Los Angeles, to nearby Beverly Hills. The active fault zone encompasses several hundred square miles of densely populated urban areas. A subsequent study of shallow-sediment folding near the surface projection of the fault inferred at least four large earthquakes with magnitudes ranging from 7.2 to 7.5 occurred over the past 11,000 years. Since 2002, the United States Geological Survey (USGS) National Seismic Hazard Maps have included this fault as active, with a magnitude range of 6.65 to 7.45.

Whittier-Elsinore Fault. The Whittier-Elsinore Fault is located approximately 1.6 miles northeast of the City of Fullerton, at its closest point. The fault extends northwest trending approximately 145 miles from the Mexican border to the northern edge of the Santa Ana

Mountains. The Whittier section of the Elsinore Fault Zone extends over 20 miles, from the Whittier Narrows southeasterly to the Santa Ana River, where it merges with the southeasterly trending Elsinore fault and other smaller faults. The unexpected, moderate-sized Whittier Narrows earthquake of October 1, 1987, occurred on the Elysian Park Fault, a buried thrust fault which is a northern extension of the Whittier fault. Movement on this fault occurs as a right-lateral strike-slip (movement is parallel to the direction or trend of the fault plane) with some reverse slip. The Whittier Fault and Elsinore Fault segments are considered capable of generating earthquakes with a magnitude of 6.0 to 7.2 and 6.5 to 7.5, respectively, on the Richter scale. This fault is considered active by the State of California and an Alquist-Priolo Special Study Zone has been established around this fault.

Newport-Inglewood Fault Zone. The Newport-Inglewood Fault Zone is located approximately 9.8 miles southwest of the City of Fullerton at its closest point. The Newport-Inglewood Fault Zone is a series of echelon northwest-trending and vertically-dipping faults extending approximately 50 miles from the southern edge of the Santa Monica Mountains southeastward to the offshore area near Newport Beach; the fault zone continues offshore southeasterly past Oceanside and is known as the Offshore Zone of Deformation. This fault has right-lateral movement, with a local reverse slip associated with fault steps. The zone is seismically active with a number of recorded earthquakes, including the historic 6.3 magnitude Long Beach Earthquake of 1933. This fault zone could generate a magnitude 6.0 to 7.2 on the Richter scale or greater credible earthquake.

Sierra Madre/San Fernando/Santa Susana Fault. The Sierra Madre/San Fernando/Santa Susana Fault is located approximately 14 miles north of Fullerton at its closest point. The central portion of this system is the San Fernando fault while the Santa Susana lies to the west and the Sierra Madre to the east. The Sierra Madre Fault is classified as a “master” fault and consists of five primary segments and thousands of feet of vertical and significant left-lateral offsets located along the base of the San Gabriel Mountains and southward up and over the San Gabriel Mountains. The fault extends for approximately 47 miles, west to east, from San Fernando to San Dimas-Claremont. The Sierra Madre Fault Zone segments consist of north-dipping reverse thrust faults. The slip rate is between approximately 0.36 and 4.0 millimeters per year (mm/yr) and may be greater at its western terminus of the fault. The Sierra Madre Fault has an expected magnitude of 6.0 to 7.0 on the Richter scale.

Palos Verdes Hills Fault. The Palos Verdes Hills Fault is located approximately 20 miles southwest of Fullerton at its closest point. The fault extends approximately 45 miles in a northwest and southeast direction. The fault has an onshore extent of approximately nine miles that extends across the Palos Verdes Peninsula. Cities close to the Palos Verdes Hills Fault include San Pedro, Palos Verdes Estates, Torrance, and Redondo Beach. This fault is considered capable of generating earthquakes in the magnitude of 6.0 to 7.0 on the Richter scale or greater. Fault geometries may allow only partial rupture during an earthquake event.

San Jacinto Fault Zone. The San Jacinto Fault is located approximately 36 miles east of Fullerton at its closest point. Segments of this fault extend from San Bernardino southeast approximately 130 miles through the Imperial Valley, and into northern Baja California. At the northern end of this fault, a right-lateral strike-slip fault appears to merge with the San Andreas Fault. Over the past century, the San Jacinto Fault has produced at least ten earthquakes, all with approximate magnitudes of 6.5 or greater on the Richter scale. Geologic, geodetic, and seismologic observations generally point to an average slip rate of eight to 12 mm/yr during

Quaternary time. This fault is considered capable of generating earthquakes in the magnitude of 6.5 to 7.5 on the Richter scale.

San Andreas Fault. The San Andreas fault system is the dominant active fault in southern California, and is believed to be the boundary between two moving subterranean crustal plates; the Pacific Plate to the southwest and the North American Plate to the northeast. The San Andreas Fault is located approximately 37 miles northeast of the City of Fullerton at its closest point. The San Andreas Fault extends more than 745 miles over the length of California. The fault is divided into segments. The San Andreas Fault has a right-lateral strike-slip movement. An earthquake along the San Andreas Fault could affect most of southern California. Several earthquakes have been historically attributed to this fault. It is estimated by geologists that this fault may be capable of generating an earthquake of magnitude 6.8 to 8.0 on the Richter scale, which is the estimated maximum credible earthquake potential.

Seismic Hazards

Earthquakes occur when the two sides of a fault slip suddenly against each other. The Pacific and North American plates move past each other approximately 1.5 inches a year. The friction between the plates causes stress, which is released when the blocks of crust slip suddenly along a fault plane. Energy is released in all directions from the source, or epicenter, in the form of seismic waves that travel through the ground, causing the ground shaking.

Earthquakes generate both primary and secondary hazards. Primary hazards involve fault rupture, strong seismic ground shaking, and resultant failure of structures. Secondary hazards result from the interaction of seismic ground shaking with existing ground instabilities and include liquefaction, lateral spreading, subsidence, settlement, and landslides. Tsunamis are also a secondary hazard resulting from earthquakes. Exhibit 5.7-2, *City of Fullerton's Earthquake Shaking Potential*, illustrates the City's earthquake shaking potential based on analyses of faults, soils, topography, groundwater, and the potential for earthquake shaking sufficiently strong to trigger secondary hazards (i.e., landslides and liquefaction). It supports the conclusion that the City is at risk to future damaging seismic hazards. The following addresses potential seismic hazards in Fullerton:

FAULT RUPTURE

The Norwalk Fault traverses the central and southeastern portion of Fullerton. The Puente Hills Fault underlies the East and West Coyote Hills located in the northern and western portions of the City. No surface faulting has been associated with either the Norwalk Fault or Puente Hills Fault. Furthermore, the City of Fullerton is not listed within a State designated Alquist-Priolo Earthquake Fault Zone. Therefore, the potential for fault rupture in the City is consider low.

STRONG SEISMIC GROUND SHAKING

Fullerton is subject to seismic ground shaking due to the close proximity and potential earthquake magnitude of nearby faults. The extent of ground shaking depends on the magnitude of the earthquake and the distance between the City and the earthquake epicenter. While the Norwalk Fault and Puente Hills Faults have the greatest potential of causing the greatest extent of ground shaking in the City, the Whittier-Elsinore Fault and Newport-Inglewood Fault could also result in significant ground shaking. According to the National Seismic Zones

Map, the City of Fullerton is situated within Zone 4, which has the highest earthquake danger of the four national seismic zones. Stronger construction standards for buildings in High Seismic Zones have been adopted in the ASCE7-05 and the Uniform Building Code.

LIQUEFACTION

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event and is associated primarily with relatively loose, saturated fine- to medium-grained unconsolidated soils. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are not uncommon in alluvial deposits in moderate to large canyons and could also be present in other areas of alluvial soils where the groundwater level is shallow (i.e., 50 feet below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

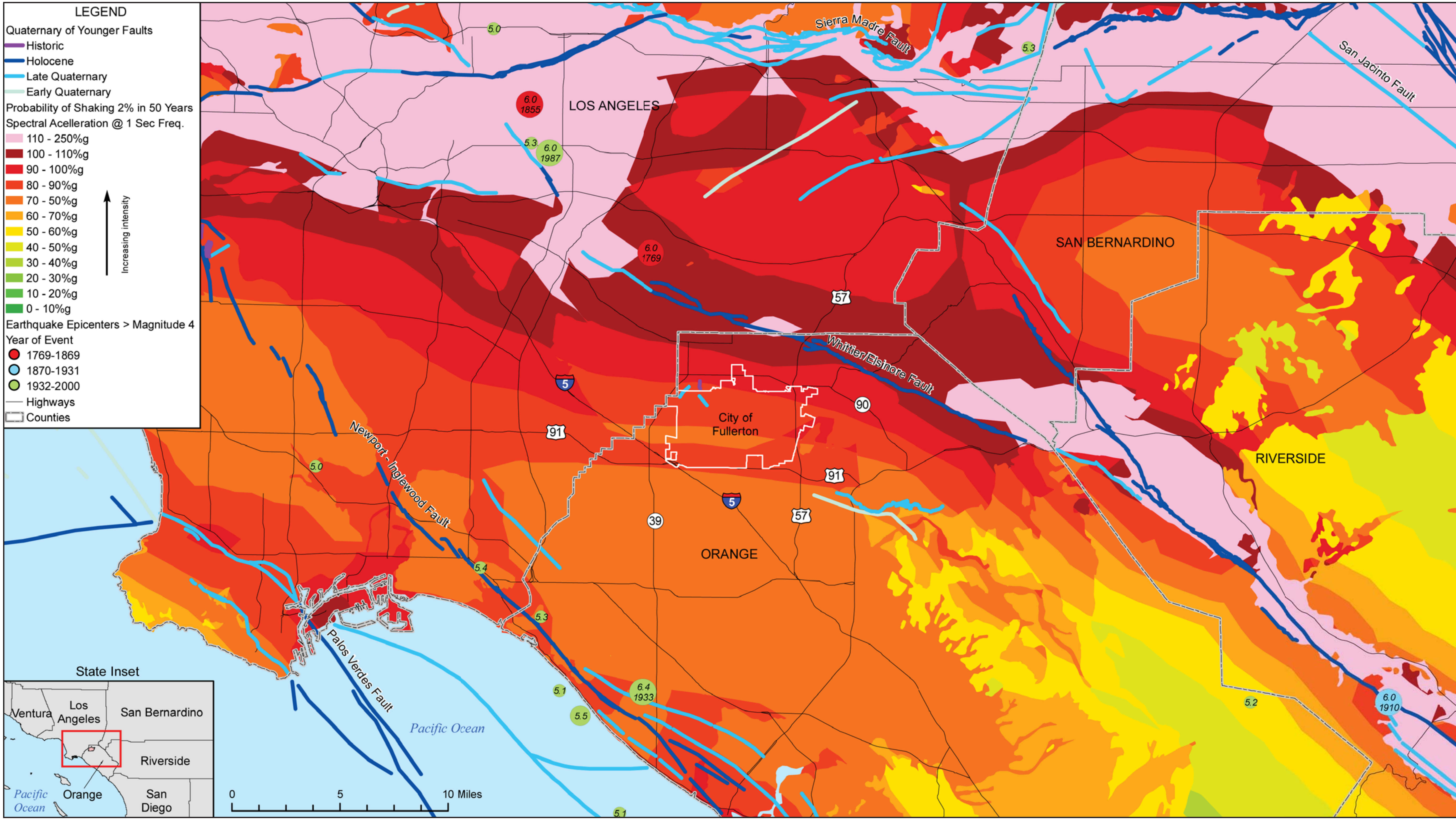
The California Geological Survey (CGS) maintains Seismic Hazards Zone Maps (the City is located within the Anaheim, Yorba Linda, and La Habra Quadrangles) that depict seismic hazards such as liquefaction and landslides. According to the CGS Quadrangles, liquefaction susceptibility is considered high throughout the City and especially within the southwestern portions; refer to Exhibit 5.7-3, *Liquefaction/Landslide Potential*. Areas of potential liquefaction are delineated based on areas of historic occurrence of liquefaction, or local geological, geotechnical, and groundwater conditions indicate a potential for permanent ground displacement.

LATERAL SPREADING

Lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. The conditions occur when blocks of mostly intact surficial soil are displaced down slope along a sheer zone that has formed within liquefied sediment. Lateral spreads most commonly occur on gentle sloping ground, and can have lateral displacement of several feet. Large displacement can occur if soil conditions have the potential for liquefaction and if seismically induced ground shaking is of a sufficient duration. According to the California Geological Survey, lateral spreading is commonly induced by liquefaction of material during an earthquake. Given the high susceptibility to liquefaction throughout the City and especially within the southwestern portions, the potential for lateral spreading is also considered high.

SUBSIDENCE

Subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow subsidence or compaction of the sediments near the Earth's surface. Settlement of under-consolidated soils may occur during earthquake shaking. This process can result in a slight lowering of the ground surface, which can vary in amount from place to place. Although not considered a major problem, areas containing zones subject to subsidence resulting from consolidations include the central and northern portions of Fullerton. Other parts of the City may experience minor subsidence from a major earthquake.



Sources: City of Fullerton, State of California and CAL OES.

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THE FULLERTON PLAN 2030
PROGRAM ENVIRONMENTAL IMPACT REPORT

City of Fullerton's Earthquake Shaking Potential

Exhibit 5.7-2

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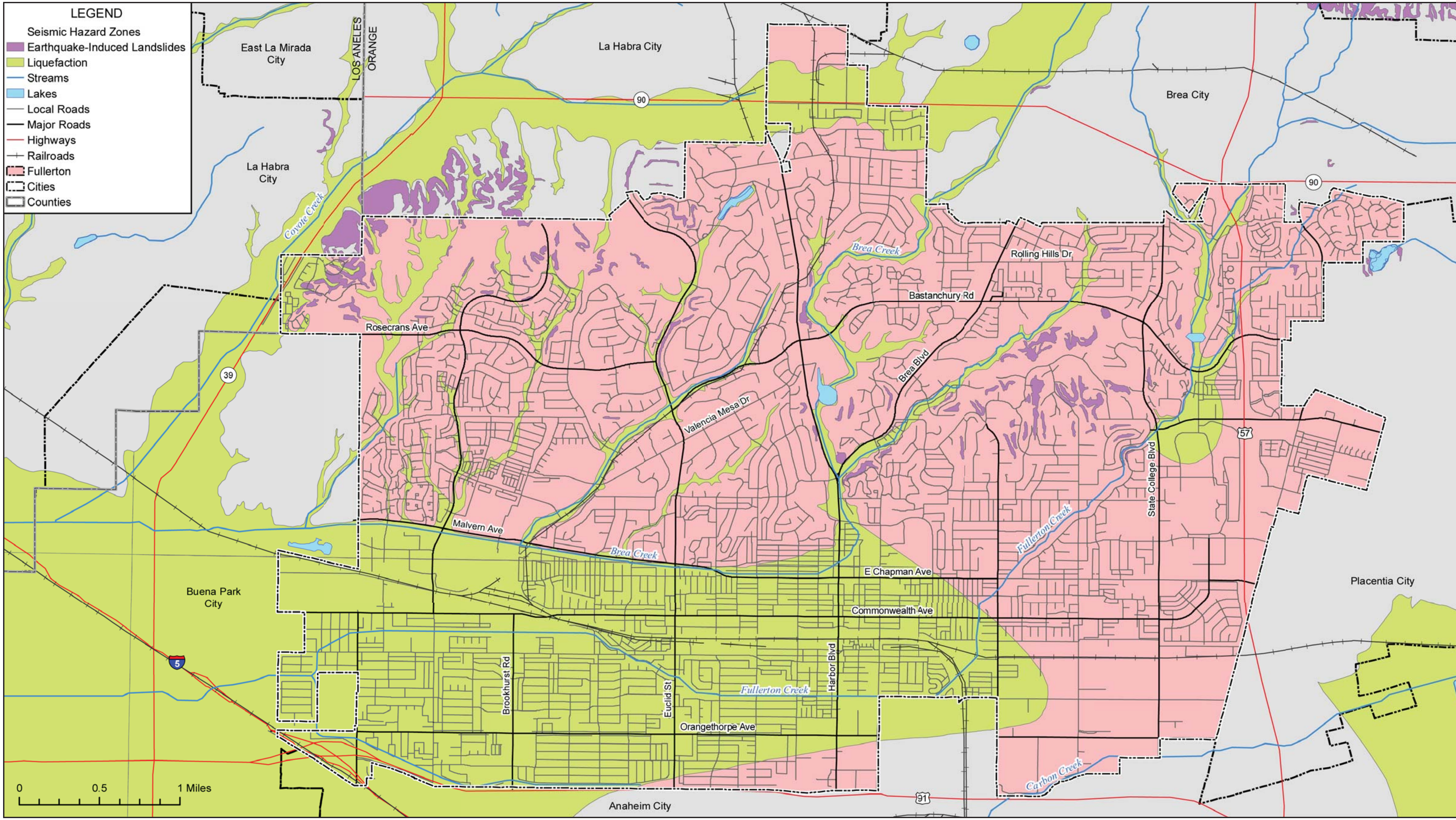

Sources: City of Fullerton, State of California, CAL OES, and the California Department of Conservation.

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THE FULLERTON PLAN 2030

PROGRAM ENVIRONMENTAL IMPACT REPORT

Liquefaction/Landslide Potential

Exhibit 5.7-3

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SETTLEMENT

Conditions of static load where subsurface densification occurs by compaction or consolidation of loose cohesionless sediment due to strong motion result in differential settlement. Settlement is characterized by surface cracking and topographic depressions ranging from a few inches to several feet and horizontally distributed over a few feet to thousands of feet. Soil conditions subject to settlement include unconsolidated soils or areas where weak soils of variable thickness overlie firm soil or bedrock. The type of materials that would most likely experience seismically-induced settlement and differential compaction are deposits of alluvium, clays, silts, and possibly poorly constructed manmade fills. If structures were built on such soil conditions, settlement damage could result in the event of strong seismic shaking.

SEISMIC-RELATED LANDSLIDES

A landslide is the descent of earth and rock down a slope. Landslides often occur along pre-existing zones of weakness within bedrock (i.e., previous failure surfaces). Additionally, landslides have the potential to occur on over-steepened slopes, especially where weak layers, such as thin clay layers, are present and dip out-of-slope. Landslides can also occur on antidip slopes, along other planes of weakness such as faults or joints. Local folding of bedrock or fracturing due to faulting can add to the potential for slope failure. Groundwater is very important in contributing to slope instability and landsliding. Additionally, other factors that contribute to slope failure include undercutting by stream action and subsequent erosion, as well as the mass movement of slopes caused by seepage or cyclical wetting and drying.

Landslide potential throughout the majority of Fullerton is considered to be low given the flat topography in most areas of the City. However, there is the potential for landslides in the steeper portions of the East and West Coyote Hills area due to the sloping topography; refer to Exhibit 5.7-2. Additionally, small soil slips can occur throughout the Coyote Hills in the newly developed portions.

TSUNAMI

A tsunami is a series of waves generated by large earthquakes that create vertical movement on the ocean floor. Tsunamis can reach more than 50 feet in height, move inland several hundred feet, and threaten life and property. Often, the first wave of a tsunami is not the largest. Tsunamis can occur on all coastal regions of the world, but are most common along margins of the Pacific Ocean. Tsunamis can travel from one side of the Pacific to the other in a day, at a velocity of 600 miles an hour in deep water. A locally generated tsunami may reach the shore within minutes. Due to its inland location, the potential for a tsunami to impact the City is considered to be low.

Geologic Hazards

Geologic hazards include landslides and subsidence. The following addresses potential hazards in Fullerton:

- ***Landslides.*** As noted in the *Seismic-Related Landslides* section above, a landslide is the descent of earth and rock down a slope. Landslide potential in Fullerton is considered to be low due to the flat topography in most areas of the City. However, there is the potential for landslides in the steeper portions of the East and West Coyote Hills area due to the sloping topography; refer to Exhibit 5.7-2. Additionally, small soil slips can occur throughout the Coyote Hills in the newly developed portions.

- ***Subsidence.*** As previously noted, subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow subsidence or compaction of the sediments near the Earth's surface. The most common type of sudden collapse is due to erosion of underground soil or rock caused by leaking human-made sewer pipes or water mains. The second most common type of sudden collapse involves dissolution of carbonate rocks (limestones) beneath the surface. Carbonate rocks such as limestone are very susceptible to dissolution by groundwater during the process of chemical weathering. Although not considered a major problem, areas subject to subsidence resulting from consolidation include the central and northern portions of Fullerton.

  Subsidence may also be caused by fluid withdrawal. If fluids are withdrawn from below the surface, a decrease in fluid pressure may occur resulting in the removal of support and possible collapse. The two most important fluids that occur beneath the surface are water (in the form of groundwater) and petroleum (in the form of oil and natural gas). Both of these fluids are often withdrawn for human use, and thus humans are often responsible for fluid withdrawal related subsidence. But, such withdrawal can also occur by natural processes. There are no known ongoing or planned large-scale extractions of groundwater or petroleum that would cause subsidence associated with fluid withdrawal within Fullerton.

Expansion and Contraction

Expansion and contraction of volume can occur when expansive soils undergo alternating cycles of wetting (swelling) and drying (shrinking). During these cycles, the volume of the soil changes markedly, and can cause structural damage to buildings and infrastructure if the potentially expansive soils were not considered in project site design and construction. Some of the soils present within the City have a high expansion potential.

Erosion

Soil erosion is defined as the detachment and movement of soil particles by the erosive forces of wind or water. Soil erosion can occur naturally or can be accelerated through the activities of human beings. Wind erosion occurs mostly in: flat, bare areas; dry, sandy soils; or anywhere the soil is loose, dry, and finely granulated. It effects include air pollution, and sediment transport and deposition, among others. Water erosion occurs due to the energy of water as it falls toward the earth and flows over the surface. The main variables affecting water erosion are precipitation and surface runoff. Surface runoff then carries away the detached soil, may detach additional soils, and ultimately deposits sediment elsewhere. Runoff is rapid and the erosion hazard is high for the following soil types that are present in the City:

- Alo clay (15 to 30 percent slopes);
- Cieneba sandy loam (30 to 75 percent slopes);
- Myford sandy loam (9 to 15 percent slopes) (moderate to high);
- Myford sandy loam (15 to 30 percent slopes);
- Myford sandy loam (9 to 30 percent slopes, eroded); and
- Xerorthents loamy.

Additionally, runoff is medium and the erosion hazard is moderate for the following soil types that are present in the City:

- Alo clay (9 to 15 percent slopes);
- Myford sandy loam (2 to 9 percent slopes);
- Rincon clay loam (2 to 9 percent slopes); and
- Rincon clay loam (9 to 15 percent slopes).

5.7.4 SIGNIFICANCE THRESHOLDS AND CRITERIA

Appendix G of the *CEQA Guidelines* contains the Initial Study Environmental Checklist, which was included with the Notice of Preparation to show the areas being analyzed within the EIR; refer to <u>Appendix A</u> of this EIR. The Initial Study includes questions relating to geology, soils, and seismicity. The issues presented in the Initial Study Checklist have been utilized as thresholds of significance in this Section. Accordingly, geology, soils, and seismicity impacts resulting from the implementation of The Fullerton Plan may be considered significant if they would result in the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving;
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction;
  - Landslides;
- Result in substantial soil erosion or the 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 landslides, lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risk to life or property; and/or

- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water (refer to Section 8.0, Effects Found Not to be Significant).

5.7.5 PROJECT IMPACTS AND MITIGATION MEASURES

FAULT RUPTURE

- **IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT EXPOSE PEOPLE AND STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS INVOLVING FAULT RUPTURE.**

Impact Analysis: As indicated in Special Publication 42, the City of Fullerton is not affected by a State-designated Earthquake Fault Zone.[4] Therefore, implementation of The Fullerton Plan would not expose people or structures to potential substantial adverse effects involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map.

Proposed General Plan Update Policies and Actions: The Fullerton Plan does not include policies or actions for fault rupture.

Mitigation Measures: No mitigation is required.

Level of Significance After Mitigation: Not applicable.

SEISMIC-RELATED HAZARDS

- **IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT EXPOSE PEOPLE AND STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS INVOLVING SEISMIC-RELATED HAZARDS.**

Impact Analysis: Buildout of The Fullerton Plan would result in the development of approximately 10,183 new dwelling units and approximately 10.7 million square feet of non-residential uses. Project implementation could expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking, seismic-related ground failure (i.e., liquefaction, lateral spreading, subsidence, and settlement), and seismic-related landslides.

Strong Seismic Ground Shaking. Two faults, the Norwalk Fault and Puente Hills Fault, traverse Fullerton. The Whittier-Elsinore Fault and Newport-Inglewood Fault are located within ten miles of the City, and several active faults that can generate strong ground shaking in Fullerton are located within 50 miles; refer to Table 5.7-1. Fullerton is subject to seismic ground shaking due to the close proximity and potential earthquake magnitude of these faults. While the Norwalk Fault and Puente Hills Faults have the greatest potential of causing the greatest

4 Ibid.

extent of ground shaking in the City, the Whittier-Elsinore Fault and Newport-Inglewood Fault could also result in significant ground shaking. 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.

Future development in accordance with The Fullerton Plan would expose a greater number of residents, employees, visitors, and structures to the effects of strong seismic ground shaking from locally and regionally generated earthquakes. The intensity of groundshaking and degree of impact would depend upon the magnitude of the earthquake, distance to the epicenter, and the geology of the area between the epicenter and the development site. Additionally, the soil and geologic structure underlying the development site would influence the amount of damage that the site may experience. Potential damage to existing and new structures cannot be precluded. Although newer structures would be anticipated to survive strong seismic ground shaking with little or no structural damage, the City contains some older structures, which have not yet been retrofitted for seismic safety. Many of the City's existing homes were constructed prior to the adoption of modern building codes, which have been established to reduce seismic impacts on structures. Strong seismic ground shaking could result in partial to total collapse of existing unreinforced masonry buildings. Structural vulnerabilities in older buildings that are less earthquake resistant are most likely to contribute to the largest source of injury and economic loss, as a result of an earthquake. Damage to infrastructure, including roadways, bridges, water and wastewater lines, gas lines, power poles, storm drainage, and other public facilities, could also occur due to an earthquake event. Therefore, project implementation could result in significant impacts regarding the exposure of people and structures to potential substantial adverse effects involving strong seismic ground shaking unless mitigated.

Seismic-Related Ground Failure (i.e., Liquefaction, Lateral Spreading, Subsidence, and Settlement). According to the CGS Quadrangles, liquefaction susceptibility is considered high throughout the City and especially within the southwestern portions; refer to Exhibit 5.7-3. According to the California Geological Survey, lateral spreading is commonly induced by liquefaction of material during an earthquake. Given the high susceptibility to liquefaction throughout the City and especially within the southwestern portions, the potential for lateral spreading is also considered high. Although not considered a major problem, areas containing zones subject to subsidence resulting from consolidations include the central and northern portions of Fullerton. Other parts of the City may experience minor subsidence from a major earthquake. Structures built on deposits of alluvium, clays, silts, and poorly constructed manmade fills would most likely experience damage due to seismically-induced settlement and differential compaction. Therefore, project implementation could result in significant impacts regarding the exposure of people and structures to potential substantial adverse effects involving seismic-related ground failure (i.e., liquefaction, lateral spreading, subsidence, and settlement), unless mitigated.

Seismic-Related Landslides. Landslide potential throughout the majority of Fullerton is considered to be low given the flat topography in most areas of the City. However, there is the potential for landslides in the steeper portions of the East and West Coyote Hills due to the sloping topography; refer to Exhibit 5.7-2. Additionally, small soil slips can occur throughout the Coyote Hills in the newly developed portions. Landslide damage would be dependant upon the level of development that is present is the area of greatest landslide activity. However landslides could block roads, damage/destroy structures, and locally disrupt water mains, sewers, and power lines. Therefore, project implementation could result in significant impacts regarding the exposure of people and structures to potential substantial adverse effects involving seismic-related landslides, unless mitigated.

Conclusion. Numerous controls would be imposed on future developments/improvements through the City's permitting process, in order to lessen impacts associated with primary (i.e., seismic ground shaking and resultant failure of structures) and secondary (liquefaction, lateral spreading, subsidence, settlement, and landslides) hazards generated by earthquakes. In general, the City regulates development (and reduces potential impacts from seismic hazards) through compliance with the Municipal Code (i.e., Building and Zoning Codes), General Plan Policies and Actions, and project-specific mitigation measures. The City's structures would be subject to compliance with the FBC and CBC, which include regulations for how buildings are designed, engineered, and constructed, and are intended to ensure the maximum structural integrity and safety of private and public buildings; refer to FMC Chapter 14.03 (Building Code). Given the City is designated Zone 4, all future development would be subject to stronger construction standards pursuant to the FBC. The primary and secondary effects of earthquakes would be sufficiently mitigated for structures designed and constructed in conformance with the FMC Chapter 14.03 (i.e., the FBC and CBC) and industry-accepted engineering standards. Any future modifications to buildings constructed prior to 1934 would be subject to compliance with the CBC, which would sufficiently mitigate potential impacts from seismic-related hazards. Future development/infrastructure would be designed to resist seismic forces in accordance with the criteria and seismic design parameters contained in the most current version of the FBC. Pursuant to Action A26.8, *Geologic Hazards*, the City would require and review Geologic Reports prior to decisions on any project that would subject property or people to significant risks from geologic hazards. The Geologic Reports would be required to describe the hazards and include mitigation measures to reduce risks to acceptable levels.

The Fullerton Plan Safety Element is divided into two chapters: Public Safety (Chapter 10); and Natural Hazards (Chapter 21). The Public Safety Chapter seeks to sustain and improve the City's commitment to safety through proactive and comprehensive police, fire, building, and code enforcement services. It is the City's goal (Goal 13) to be responsive to public safety needs. To this end, Policy P13.3 is to support policies, projects, programs, and regulations that reduce structural and nonstructural hazards to life safety, minimize property damage and resulting social, cultural, and economic dislocations resulting from future disasters. It is also the City's policy (Policy P13.5) to support policies, programs, and regulations that ensure the City, its residents, businesses, and services are prepared for effective response and recovery in the event of emergencies or disasters. The Fullerton Plan Natural Hazards Element seeks to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from natural hazards within or affecting Fullerton. Goal 26 is to protect people, the natural and built environments, and the economy from natural hazards. To this end, Policy P26.4 is to support projects, programs, policies, and regulations to discourage or limit development within areas that are vulnerable to natural disasters, particularly in areas with recurring damage and/or the presence of multiple natural hazards. It is also the City's policy (Policy P26.5*)* to support projects, programs, policies, and regulations to utilize hazard specific development regulations to mitigate risks associated with identified potential natural hazards when development does occur. The City of Fullerton Local Hazard Mitigation Plan (LHMP) has been adopted as part of The Fullerton Plan Safety Element. The LHMP is provided in The Fullerton Plan Appendix N and addresses safety issues related to natural disasters, fire and police emergencies, and building and code enforcement. The LHMP includes detailed policies and actions that reinforce the general policies and actions within The Fullerton Plan Chapters 10 and 21. Additional Policies and Actions intended to mitigate seismic-related hazards are outlined below. Compliance with the FBC, CBC, and The Fullerton Plan Policies and Actions would lessen potential impacts associated with strong seismic ground shaking, seismic-related ground failure (i.e., liquefaction, lateral spreading, subsidence, and settlement), and seismic-related landslides to less than significant levels.

Proposed General Plan Update Policies and Actions:

P13.1 ***Inter-City Coordination***
Support regional and subregional efforts to: coordinate as appropriate Continuity of Operations Plan, plans and procedures for Emergency Operations Centers, and emergency response training systems; maintain inter-agency and public communications systems that will provide mutual aid and be reliable during and following an emergency; and, formulate definitive plans and procedures for evacuation of hazard-prone areas and high risk uses.

P13.2 ***Adequate Resources for Emergencies***
Support policies and programs that ensure adequate resources are available in all areas of the City to respond to health, fire, and police emergencies.

P13.3 ***Disaster Hazard Reduction***
Support policies, projects, programs and regulations that reduce structural and non-structural hazards to life safety, minimize property damage and resulting social, cultural and economic dislocations resulting from future disasters.

P13.4 ***Disaster Risk Reduction***
Support programs that promote greater public awareness of disaster risks, personal and business risk reduction, and personal and neighborhood emergency response.

P13.5 ***Community Emergency Preparedness***
Support policies, programs and regulations that ensure the City, its residents, businesses, and services are prepared for effective response and recovery in the event of emergencies or disasters, including the provision of information about the current nature and extent of local safety hazards and emergency plans, including evacuation plans and procedures to accommodate special needs populations (information should be provided in multiple languages to maximize understanding by community members).

P13.6 ***Inter-Department Coordination***
Support policies and programs that improve the coordination of disaster-related programs within City departments.

P13.8 ***Staff Training on Structural Risks***
Support programs for ongoing staff training focused on the risks posed by older structures and infrastructure, as well as how to reduce those risks.

P13.9 ***Nuisance Enforcement***
Support policies, programs, and regulations that maintain or strengthen code enforcement as an important tool to uphold community health, safety and welfare consistent with the provisions of the Fullerton Municipal Code.

P13.10 ***Community Education on Emergency***
Preparedness Support policies and programs to involve and educate the Fullerton community in emergency preparedness.

A13.1 ***CERT Program***
Promote and conduct seminars in schools and other civic and neighborhood locations to teach citizens how to prepare for potential emergencies and provide ample opportunities for Community Emergency Response Training (CERT) so that community members can serve as civilian volunteers during an emergency.

P26.1 ***Regional Coordination***
Support projects, programs, policies and regulations to coordinate planning for and response to natural disasters with other agencies within the region.

P26.2 ***Adequate Emergency Response***
Infrastructure Support projects, programs, policies and regulations to prepare to respond to natural disasters to the best of the City's ability.

P26.3 ***Focus Area Planning***
Support projects, programs, policies and regulations to consider natural hazard risks and mitigation as part of community-based planning of Focus Areas.

P26.4 ***Minimization of Development in High Risk Areas***
Support projects, programs, policies and regulations to discourage or limit development within areas that are vulnerable to natural disasters, particularly in areas with recurring damage and/or the presence of multiple natural hazards.

P26.5 ***Hazard Specific Development Regulations***
Support projects, programs, policies and regulations to utilize hazard specific development regulations to mitigate risks associated with identified potential natural hazards, including flooding, wildland fires, liquefaction, and landslides when development does occur.

A26.2 ***Project Review***
Review the City's natural hazards maps (Exhibits 15 through 19) to determine potential risks to people and buildings and to develop appropriate mitigation measures to address and minimize risks.

A26.5 ***Geologic Hazards***
Require and review geologic reports prior to decisions on any project that would subject property or people to significant risks from the geologic hazards (refer to Exhibits 15 through 19). Geologic reports should describe the hazards and include mitigation measures to reduce risks to acceptable levels.

A26.6 *Implementation of Recommended Mitigation Actions*
Pursue the implementation of the recommended mitigation actions included in Table 5.1 of the adopted City of Fullerton Local Hazard Mitigation Plan or as otherwise provided by the Mitigation Action Plan (Section 5.4) based on priority, funding availability or other circumstances.

Mitigation Measures: No further mitigation is required beyond compliance with the proposed General Plan Update Policies and Actions.

Level of Significance After Mitigation: Less Than Significant Impact.

SOIL EROSION

- **IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT RESULT IN SUBSTANTIAL SOIL EROSION OR THE LOSS OF TOPSOIL.**

Impact Analysis: As previously noted, runoff is medium to rapid and the erosion hazard is moderate to high for various soil types that are present in the City. However, the City is approximately 90 percent built-out (exclusive of open space and parks and recreational facilities) and has a relatively flat topography. Therefore, conditions that contribute to substantial soil erosion or loss of topsoil are not present within most of the City. However, soil erosion can become a problem when human activities accelerate the rate at which soils are displaced. Sheet flow drainage, impervious surfaces (e.g., concrete or asphalt paving and structures), construction activities, and unpaved roads can all accelerate the rate at which soils are removed. Generally, the long-term effects of wind and water erosion, which occur on vacant properties, are anticipated to decrease as development and improvements increase. Notwithstanding, in order to minimize soil erosion, all future development projects would be subject to compliance with the FMC. More specifically, FMC Chapter 12.18 (Water Quality Ordinance) includes conditions and requirements related to the reduction or elimination of pollutants (including eroded soils) in stormwater runoff from a project site. FMC Section 14.03.170 (Amendment to Appendix J, Section J109.4 [Erosion Control Devices]), specifies the requirements relative to temporary and permanent desilting catch basins, drainage, surfacing, slope planting, and other erosion control devices. Additionally, FMC Section 14.03.190 (Amendment to Appendix J, Section J110 [Erosion Control]), specifies that all fill and cut slopes in designated hillside areas which are determined by the Building Official to be subject to erosion shall be planted and irrigated to protect the slopes against erosion, as required in this section. Where deemed necessary by the Building Official, check dams, cribbing, riprap or other methods and devices shall be installed to control erosion and to promote slope stability. Moreover, as discussed in EIR Section 5.8, Water Quality and Drainage, it is the City's goal (Goal 20) to maintain a healthy watershed and clean urban runoff. To this end, compliance with NPDES standards and implementation of Best Management Practices (BMP) would be required in new developments, in order to minimize short- and long-term erosion. Therefore, following compliance with NPDES and Code requirements, and The Fullerton Plan Goals and Actions, implementation of The Fullerton Plan would result in less than significant impacts involving soil erosion or the loss of topsoil.

Proposed General Plan Update Policies and Actions:

P20.1 ***Regional Watersheds***
Support regional and subregional efforts to support functional and healthy watersheds.

P20.2 ***Urban Runoff Management***
Support regional and subregional efforts to support cleaner and reduced urban runoff.

P20.4 ***Local Watersheds***
Support projects, programs, policies and regulations that support a functional and healthy watershed within neighborhoods and districts.

P20.5 ***Water Quality of Focus Areas***
Support projects, programs, policies and regulations to encourage site and infrastructure improvements within the City's Focus Areas to support cleaner and reduced urban runoff.

P20.6 ***Construction Impacts***
Support projects, programs, policies and regulations to reduce impacts to watersheds and urban runoff caused by private and public construction projects.

P20.7 ***Development Impacts***
Support projects, programs, policies and regulations to reduce impacts to watersheds and urban runoff caused by the design or operation of a site or use.

A20.1 ***Revise Street Standards***
Revise the City's street standards to allow and encourage bio-filtration systems/ planters and the use of permeable pavement.

A20.2 ***Green Streets and Parking Lots***
Implement demonstration projects in select neighborhoods and districts to show how streets and parking lots can be improved with bio-filtration systems/planters and the use of permeable pavement.

P24.6 ***Watershed Management***
Support projects, programs, policies and regulations to manage open space watersheds to limit potential fire and erosion hazards.

Mitigation Measures: No further mitigation is required beyond compliance with the proposed General Plan Update Policies and Actions.

Level of Significance After Mitigation: Less Than Significant Impact.

UNSTABLE GEOLOGIC UNITS

- **IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT RESULT IN DEVELOPMENT/IMPROVEMENTS THAT ARE LOCATED ON A GEOLOGIC UNIT OR SOIL THAT IS UNSTABLE, RESULTING IN LANDSLIDES OR SUBSIDENCE.**

Impact Analysis: Project implementation could result in development/improvements that are located on a geologic unit or soil that is unstable, or that would become unstable, and potentially result in landslides or subsidence.

Landslides (Non-Seismic). Although, landslide potential in Fullerton is considered to be low due to the flat topography in most areas of the City, there is the potential for landslides in the steeper portions of the East and West Coyote Hills due to the sloping topography. Additionally, small soil slips can occur throughout the Coyote Hills in the newly developed portions. As noted above, landslides could block roads, damage/destroy structures, and locally disrupt water mains, sewers, and power lines. Therefore, project implementation could result in significant impacts involving landslides, unless mitigated.

Subsidence. Although not considered a major problem, areas subject to subsidence resulting from consolidation include the central and northern portions of Fullerton. Notwithstanding, subsidence can result in the weakening or collapse of buildings, twisting/breaking of railway lines and roads, and disruption or tearing apart of underground water, sewer, and power lines. Therefore, project implementation could result in significant impacts involving landslides, unless mitigated.

It is noted, there are no known ongoing or planned large-scale extractions of groundwater or petroleum that would cause subsidence associated with fluid withdrawal within Fullerton.

Conclusion. Numerous controls would be imposed on future developments/improvements through the City's permitting process, in order to lessen impacts associated with unstable geologic/soil units (i.e., landslides and subsidence). The City's structures would be subject to compliance with the FBC and CBC, which include regulations for how buildings are designed, engineered, and constructed, and are intended to ensure the maximum structural integrity and safety of private and public buildings. The potential impacts associated with landslides and subsidence would be sufficiently mitigated for structures designed and constructed in conformance with the FMC Chapter 14.03 (i.e., the FBC and CBC) and industry-accepted engineering standards. In accordance with Action A26.8, *Geologic Hazards*, the City would require and review Geologic Reports prior to decisions on any project that would subject property or people to significant risks from geologic hazards. As noted above, Goal 26 is to protect people, the natural and built environments, and the economy from natural hazards. To this end, all future development/improvements would be subject to compliance with Policy P26.4 and Policy P26.5. Additional Policies and Actions intended to mitigate landslides and subsidence are outlined in the *Seismic Hazards* Section above. Potential impacts would be reduced to less than significant following compliance with The Fullerton Plan Policies and Actions intended to mitigate geologic hazards (i.e., landslides and subsidence), as outlined in the *Seismic Hazards* Section above.

Proposed General Plan Update Policies and Actions: Refer to the Policies and Actions cited above.

Mitigation Measures: No further mitigation is required beyond compliance with the proposed General Plan Update Policies and Actions.

Level of Significance After Mitigation: Less Than Significant Impact.

EXPANSIVE SOILS

- **IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT RESULT IN DEVELOPMENT/IMPROVEMENTS THAT ARE LOCATED ON EXPANSIVE SOILS, RESULTING IN RISK TO LIFE OR PROPERTY.**

Impact Analysis: Project implementation could result in development/improvements that are located on expansive soils. Expansive soil, also called shrink-swell soil, is a very common cause of foundation problems. Expansive foundation soils can cause lifting (i.e., heave) of a building or other structure during periods of high moisture. Conversely, during periods of decreasing soil moisture, expansive soil can collapse resulting in building settlement. Additionally, pressure is exerted on the vertical face of a foundation, basement, or retaining wall due to expansive soils, resulting in lateral movement. Expansive soils can result in a loss of soil strength, resulting in instability and various forms of foundation problems. Therefore, project implementation would result in significant impacts involving expansive soils, unless mitigated. However, numerous controls would be imposed on future developments/improvements through the City's permitting process, in order to lessen impacts associated with expansive soils. The potential impacts associated with expansive soils would be sufficiently mitigated for structures designed and constructed in conformance with the FMC Chapter 14.03 (i.e., the FBC and CBC) and industry-accepted engineering standards. In accordance with Action A26.8, *Geologic Hazards*, the City would require and review Geologic Reports prior to decisions on any project that would subject property or people to significant risks from geologic hazards. Regulating or restricting construction in areas with soil stability problems can reduce potential impacts associated with geologic hazards. Impacts can also be reduced by grading and engineering methods, which provide a stable foundation for building construction. Potential impacts would be reduced to less than significant following compliance with The Fullerton Plan Policies and Actions intended to mitigate geologic hazards (i.e., expansive soils), as outlined in the *Seismic Hazards* Section above.

Proposed General Plan Update Policies and Actions: Refer to the Policies and Actions cited above.

Mitigation Measures: No further mitigation is required beyond compliance with the proposed General Plan Update Policies and Actions.

Level of Significance After Mitigation: Less Than Significant Impact.

5.7.6 CUMULATIVE IMPACTS

- **FUTURE DEVELOPMENT RESULTING FROM IMPLEMENTATION OF THE FULLERTON PLAN WOULD NOT RESULT IN CUMULATIVE IMPACTS RELATED TO SEISMIC, GEOLOGIC, AND SOIL CONDITIONS.**

Impact Analysis: Seismic, geologic, and soil conditions in the region would vary by location and their suitability for development would not be uniform. Future development sites may exhibit constraints to development that would be addressed at the geotechnical engineering level. Short-term cumulative impacts such as erosion would occur. Implementation of The Fullerton Plan combined with cumulative development projects would incrementally increase the number of people and/or structures potentially subject to a seismic or geologic hazard. Unsafe seismic, geologic, and soil conditions exist throughout southern California and new development in such areas could result in potentially significant impacts. These potential impacts would be evaluated on a project-by-project basis in accordance with CEQA. Such exposure would be minimized through strict engineering guidelines for development at each respective development site. Future development would be subject to compliance with the provisions of The Fullerton Plan and Municipal Codes of each respective site. Mitigation would be incorporated on a project-by-project basis to reduce cumulative seismic, geologic, and soil impacts to a less than significant level. If a specific site were determined to create a significant impact that could not be feasibly mitigated, the site would not be appropriate for development. These processes, along with compliance with Safety Element goals and policies, Federal and State laws, local building codes, and public safety standards would result in less than significant cumulative impacts related to potential seismic, geologic, and soil hazards. Therefore, the project's contribution to these impacts would not be cumulatively considerable and cumulative impacts associated with geology and soils within the region would be less than significant.

Proposed General Plan Update Policies and Actions: Refer to the Policies and Actions cited above.

Mitigation Measures: No further mitigation is required beyond compliance with the proposed General Plan Update Policies and Actions.

Level of Significance After Mitigation: Less Than Significant Impact.

5.7.7 SIGNIFICANT UNAVOIDABLE IMPACTS

No significant unavoidable seismic, geologic, or soil impacts would occur as a result of buildout of The Fullerton Plan.

5.7.8 SOURCES CITED

City of Fullerton, *City of Fullerton General Plan,* 1996.

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