Section 3.6
Geology, Soils, and Paleontological Resources

3.6.1 Introduction

This section describes the geographic and regulatory setting, as well as the potential project impacts related to geology, soils, seismicity, and paleontological resources. Where needed, this section identifies mitigation measures that would reduce or avoid any significant impacts, when feasible.

The analysis in this section includes impact determinations under CEQA for the *2020 LA River Master Plan* that are applicable to all 18 jurisdictions in the study area, including the County and non-County jurisdictions (17 cities). Except for significant and unavoidable impacts, all identified significant environmental effects of the proposed *2020 LA River Master Plan* can be avoided or reduced to a less-than-significant level if the mitigation measures identified in this PEIR are implemented. These mitigation measures will be implemented for subsequent projects that are carried out by the County. Because some later activities under the *2020 LA River Master Plan* would not be carried out by the County, the County cannot enforce or guarantee that the mitigation measures would be incorporated. Therefore, where this PEIR concludes a less-than-significant impact for later activities carried out by the County, the impact would be significant and unavoidable when these activities are not carried out by the County.

3.6.2 Setting

3.6.2.1 Geologic Setting

Regional Setting

Geology

The upper portion of the LA River (north of the Hollywood Hills and Santa Monica Mountains) is within the San Fernando Valley. The San Fernando Valley and adjacent mountains are part of the Transverse Ranges geomorphic province that is composed of parallel, east- to west-trending mountain ranges and sediment-filled valleys. The province is one of the most seismically active in the U.S. The distinctive geological structure of the Transverse Ranges is dominated by the effects of north-south compressive deformation resulting in thrust faulting, strike-slip faulting, and bedrock folding (USGS 2016).

The lower portion of the LA River is within the Los Angeles Basin. The present-day Los Angeles Basin is a northwest-trending alluvial plain, sometimes called the coastal plain, about 50 miles long and 20 miles wide, on the coast of Southern California, bounded on the north by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills and on the east and southeast by the Santa Ana Mountains and San Joaquin Hills. The low land surface slopes gently south or seaward, interrupted by the Coyote Hills near the northeast margin, a line of elongated low hills to the south and west that extend from Newport Bay northwest to Beverly Hills, and by the Palos Verdes peninsula along the southwest extremity (Ninyo and Moore 2018).

The physiographic basin is underlain by a structural depression, parts of which have been the sites of discontinuous deposition since Late Cretaceous time (last period of the Mesozoic era) and of continuous subsidence and chiefly marine deposition since middle Miocene time. The most distinctive geologic characteristic of the Los Angeles Basin is its structural relief and complexity in relation to its age and size. Continuous subsidence and deposition in late Miocene and Pliocene time caused variations in lithology and thickness in most of the sedimentary rock units; contemporaneous folding and faulting along with erosion resulted in numerous regional and local unconformities, disconformities, and stratigraphic discontinuities across faults. The Los Angeles Basin is California's most prolific oil-producing district in proportion to its size: at the end of 1961, its cumulative production was nearly half that of the entire State. For more information on current oil production in the study area, see Section 3.11, *Mineral Resources.*

Coastal Southern California includes parts of three geomorphic provinces: Coast Ranges, Transverse Ranges, and Peninsular Ranges. The western parts of all three provinces are submerged below the Pacific Ocean. The Coast Ranges province, which extends north from the Transverse Ranges province into central California, and the Peninsular Ranges province, which extends south into Baja California, have conspicuous northwest trends and are transected by the east-trending ridges and valleys of the Transverse Ranges province. The present-day Los Angeles Basin is at the northern end of the Peninsular Ranges province.

The stratigraphic units of southwestern California, including those of the Los Angeles Basin, are separated into two large groups by a pronounced unconformity of mid-Cretaceous age. Below the unconformity are basement rocks composed of metamorphic and igneous crystalline rocks of Precambrian to early Late Cretaceous age; above the unconformity is a thick succession of marine and non-marine sedimentary and volcanic rocks of Late Cretaceous to Recent age, the superjacent rocks (Yerkes et al. 1965).

Surficial deposits identified in the *2020 LA River Master Plan* study area (below) include a general description of their characteristics found within each jurisdiction's specific general plans. However, according to the Natural Resources Conservation Service's Web Soil Survey, primary soil components along and adjacent to the river footprint are classified as Urban Land; secondary soil characteristics vary significantly (Natural Resources Conservation Service 2019). Urban Land typically consists of areas with high population density in a largely built environment, which is the most common description of the land surrounding the LA River corridor. According to the Natural Resources Conservation Service, human-transported materials, human-altered materials, or minimally altered or intact "native" soils can significantly change existing soils and exhibit a wide variety of conditions and properties (U.S. Department of Agriculture 2019).

Faulting and Seismicity

The faults in Southern California are classified as active, potentially active, and inactive. As defined by the California Geological Survey (CGS), active faults are those that have ruptured within Holocene time or approximately the last 11,000 years. Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years), but for which evidence of Holocene movement has not been established. Inactive faults have not ruptured in the last approximately 1.6 million years (Ninyo and Moore 2018).

Principal Faults

Principal known active faults in the Los Angeles area are listed below:

- Anacapa-Dume
- Hollywood
- Newport–Inglewood
- Northridge
- Oak Ridge
- Palos Verdes
- Puente Hills Blind Thrust
- Raymond
- San Andreas
- San Gabriel
- San Joaquin Hills Blind Thrust
- San Jose
- Santa Monica
- Santa Susana
- Sierra Madre
- Simi-Santa Rosa
- Upper Elysian Park Blind Thrust
- Verdugo
- Whittier

Historic Earthquakes

Surface Rupture

Surface fault rupture is the offset or rupturing of the ground surface by relative displacement across a fault during an earthquake. According to CGS's *Earthquake Zones of Required Investigation* (CGS 2016), the Newport–Inglewood and Hollywood fault zones cross the LA River footprint and, although individual projects are not known at this time, it is possible that some sites may be within an Earthquake Fault Zone (EFZ). Figure 3.6-1 identifies the principal faults.

Ground Motion

The Los Angeles area is seismically active, as is the majority of Southern California. Table 3.6-1 lists known active faults in the area and the maximum moment magnitude, as published by the U.S. Geological Survey (USGS). *Magnitude* is a number that characterizes the relative size of an earthquake and is based on measurement of the maximum motion recorded by a seismograph.

Earthquake events from one of the regional active or potentially active faults could result in strong ground shaking, which could affect any site within the LA River area. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the epicenter, and subsurface geologic conditions.

Table 3.6-1. Principal Faults and Maximum Moment Magnitude

Fault	Maximum Moment Magnitude (M_{max})
Anacapa–Dume	7.2
Hollywood	6.7
Newport–Inglewood	7.5
Northridge	6.9
Oak Ridge	7.2
Palos Verdes	7.7
Puente Hills Blind Thrust	7.0
Raymond	6.8
San Andreas	8.2
San Gabriel	7.4

Fault	Maximum Moment Magnitude (M_{max})
San Joaquin Hills Blind Thrust	7.1
San Jose	6.7
Santa Monica	7.4
Santa Susana	6.9
Sierra Madre	7.3
Simi–Santa Rosa	6.9
Upper Elysian Park Blind Thrust	6.7
Verdugo	6.9
Whittier	7.9

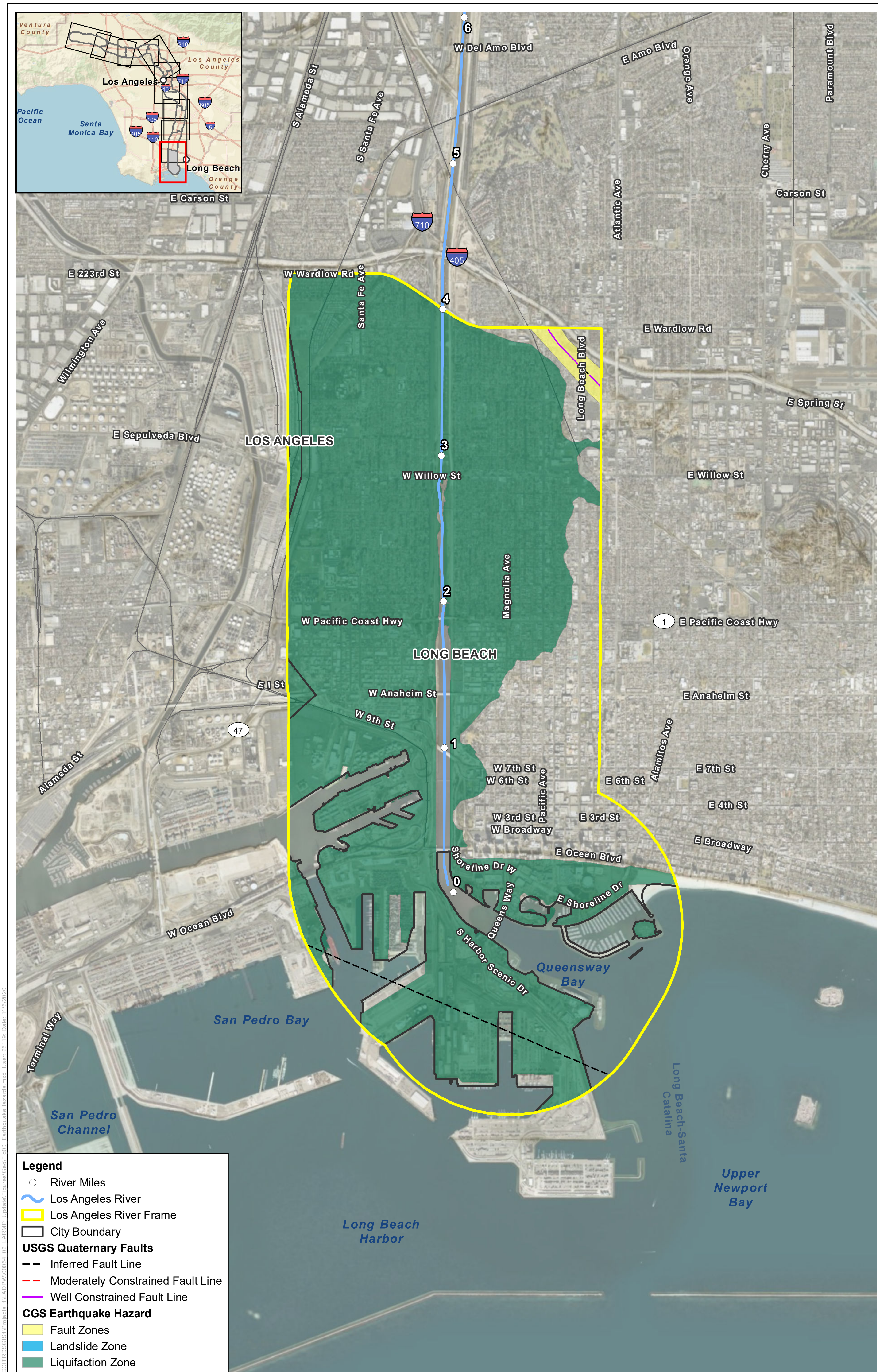
Secondary Seismic Effects

Liquefaction occurs when saturated, low-density, loose materials (e.g., sand or silty sand) are weakened and transformed from a solid to a near-liquid state as a result of increased pore water pressure. The increase in pressure is caused by strong ground motion from an earthquake. Liquefaction more often occurs in areas underlain by silts and fine sands and where shallow groundwater exists. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking. The potential damaging effects of liquefaction include differential settlement, loss of ground support, ground cracking, and heaving and cracking of slabs due to sand boiling or settlement. Portions of the Los Angeles Basin, San Fernando Valley, San Pedro area, and other low-lying areas with shallow groundwater are considered susceptible to liquefaction. According to CGS's *Earthquake Zones of Required Investigation*, a large portion of the LA River is within a liquefaction zone. See Figures 3.6-1 through 3.6-9 for liquefaction zones.

Landslides, slope failures, and mudflows of earth materials generally occur where slopes are steep and/or the earth materials are too weak to support themselves. Earthquake-induced landslides may also occur due to seismic ground shaking. According to CGS's *Earthquake Zones of Required Investigation*, areas adjacent to the LA River near Elysian Park, Glendale, and Burbank are in landslide zones (California Department of Conservation 2019). Figures 3.6-5 through 3.6-9 depict areas that are generally susceptible to landslides.

Subsidence is characterized as a sinking of the ground surface relative to surrounding areas and can generally occur where deep soil deposits are present. Subsidence in areas of deep soil deposits is typically associated with regional groundwater withdrawal or other fluid withdrawal from the ground, such as oil and natural gas. Subsidence can result in the development of ground cracks and damage to sidewalks, pipelines, and other improvements. Areas throughout the Los Angeles Basin used for oil extraction have had various degrees of land subsidence.

Compressible soils are generally composed of soils that undergo consolidation when exposed to new loading, such as fill or foundation loads. *Soil collapse* is a phenomenon in which the soils undergo a significant decrease in volume with an increase in moisture content, with or without an increase in external loads. Buildings, structures, and other improvements may be subject to excessive settlement-related distress when compressible soils or collapsible soils are present. Given the



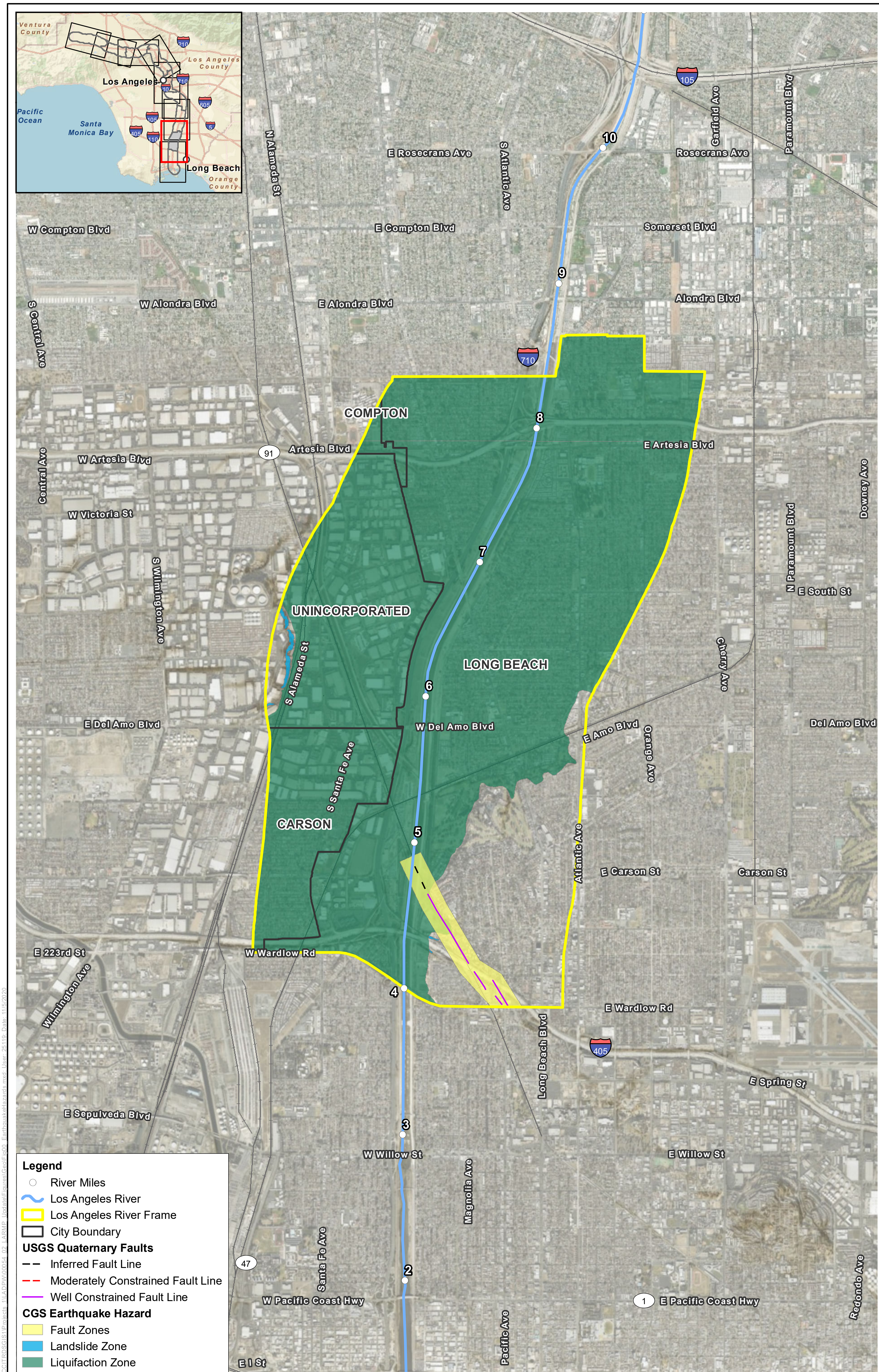
N

0 1,625 3,250 Feet

1:39,000

Source: County of Los Angeles; ESRI

Frame 1 - Estuary
Earthquake Hazard Zones



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0 1,625 3,250 Feet

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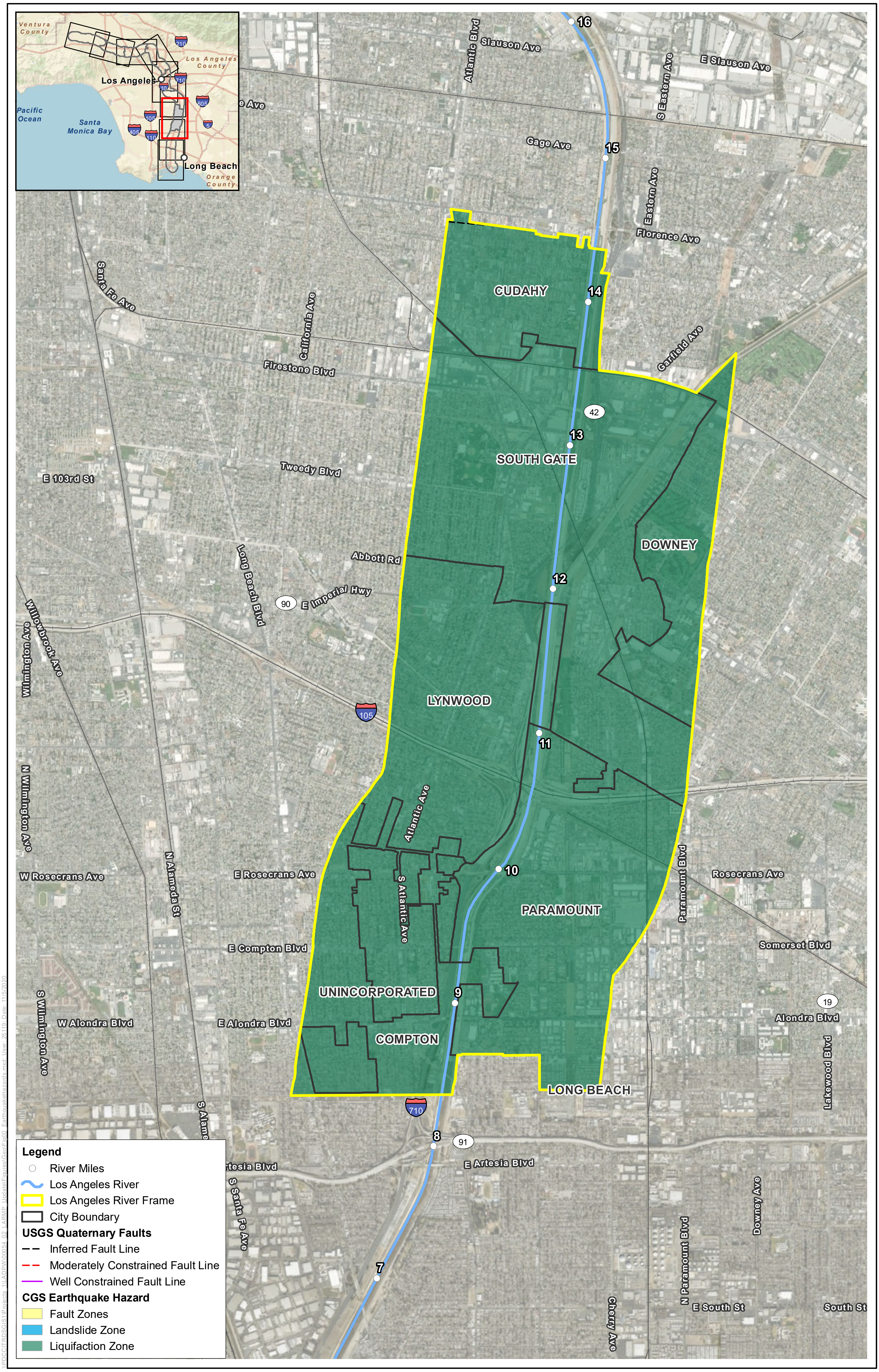
Source: County of Los Angeles; ESRI

Frame 2 - South Plain
Earthquake Hazard Zones



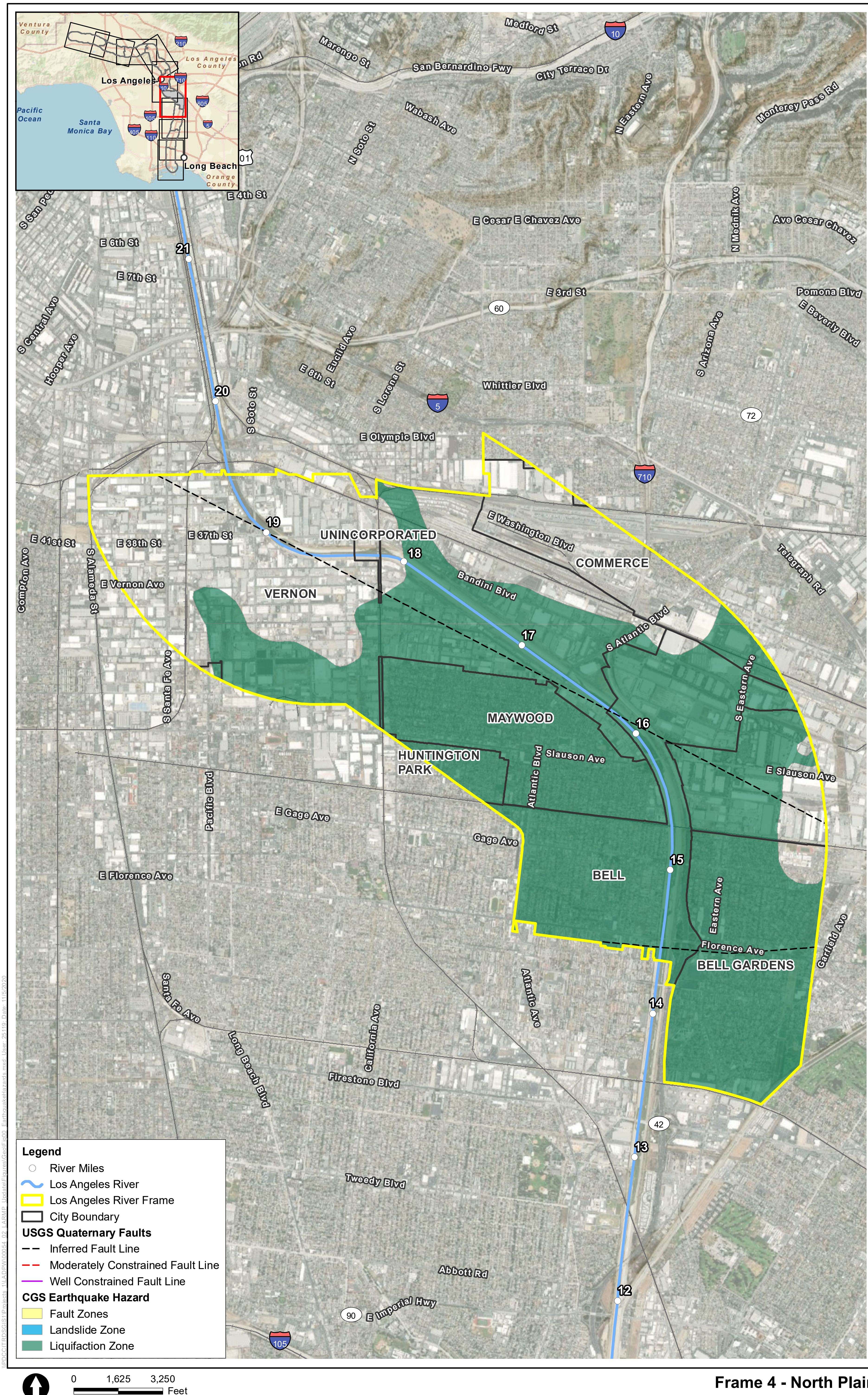
N

0 1,625 3,250 Feet

1:39,000

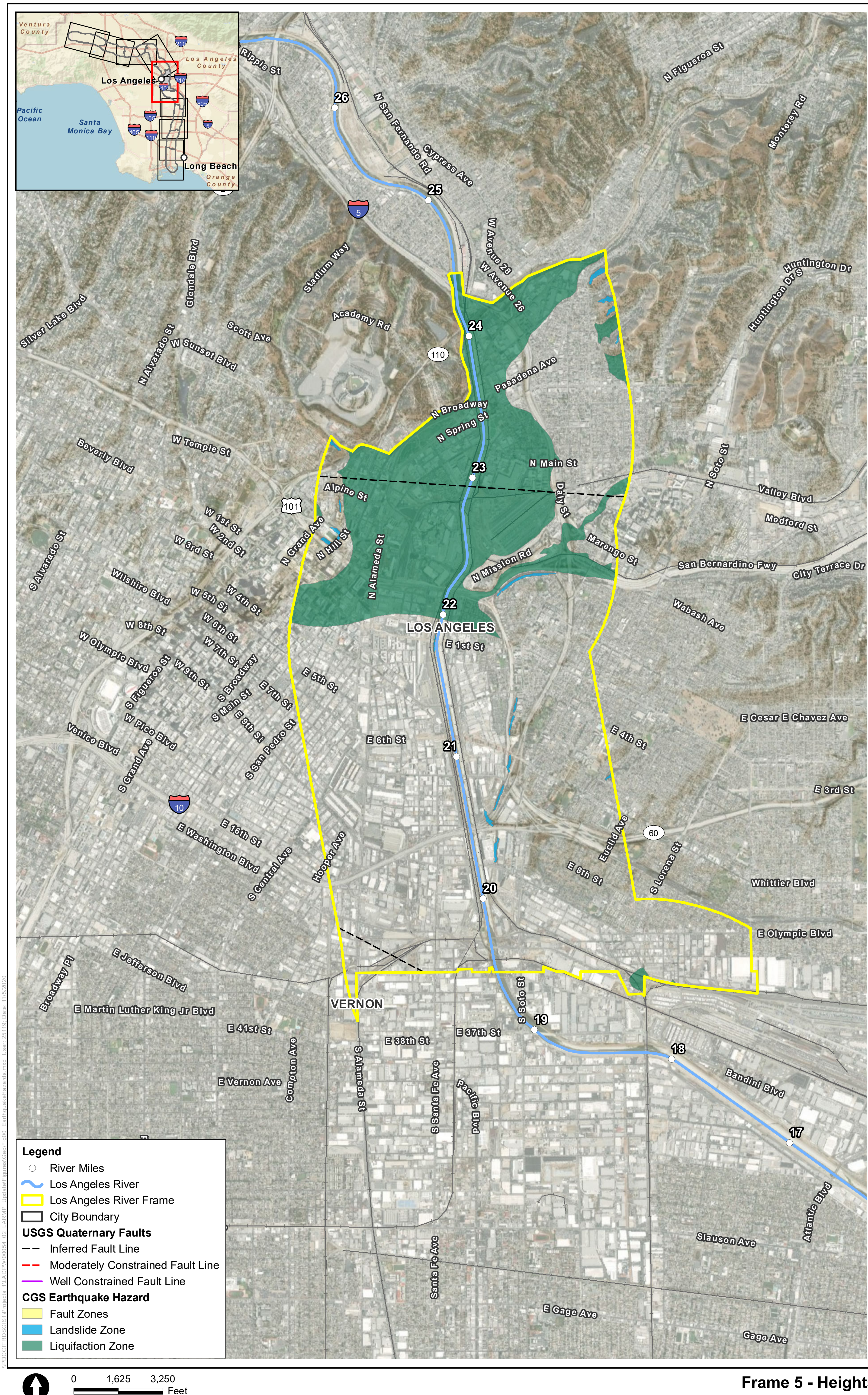
Source: County of Los Angeles; ESRI

Frame 3 - Central Plain
Earthquake Hazard Zones



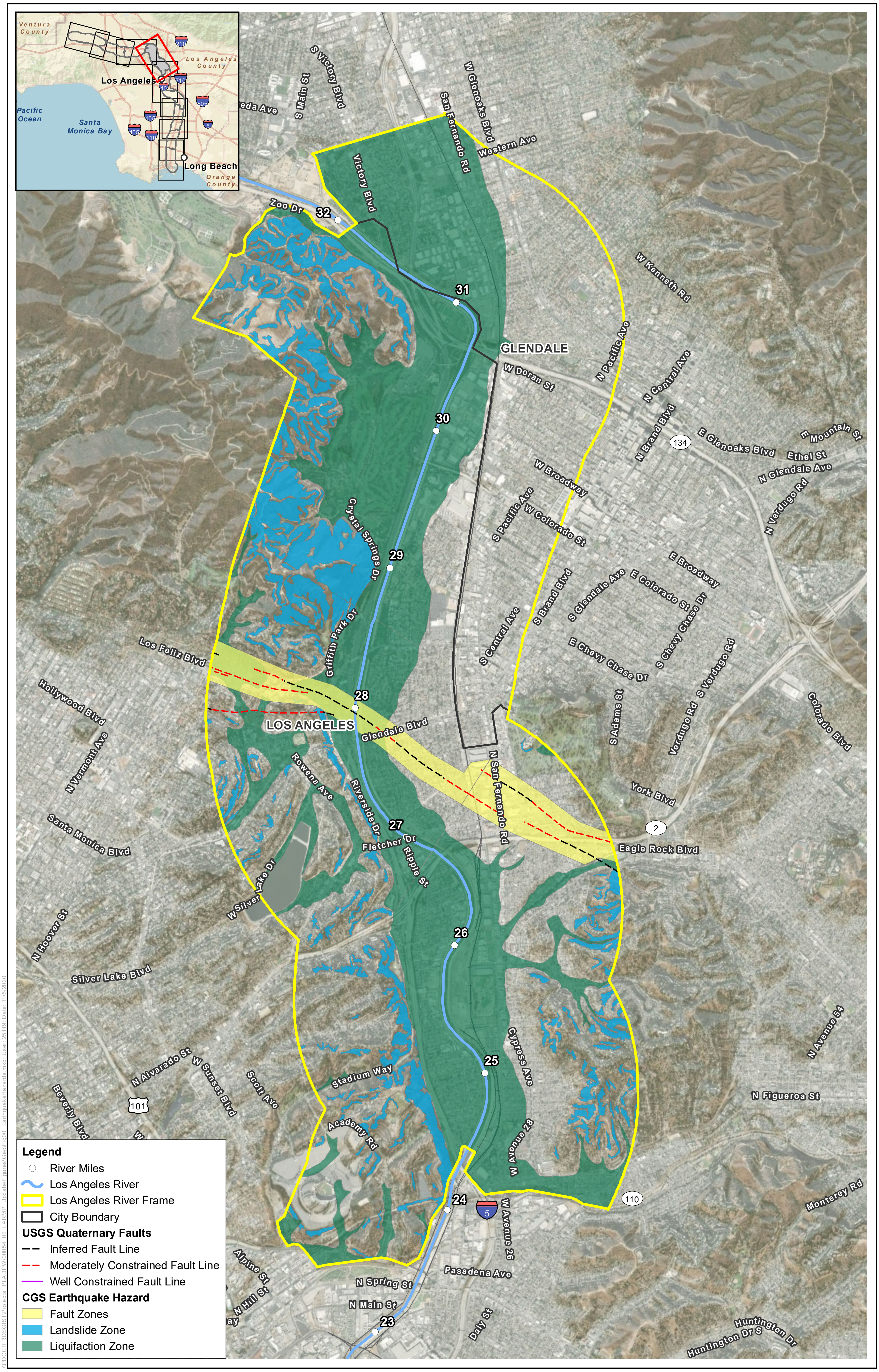
Frame 4 - North Plain
Earthquake Hazard Zones

Source: County of Los Angeles; ESRI



Source: County of Los Angeles; ESRI

Frame 5 - Heights
Earthquake Hazard Zones



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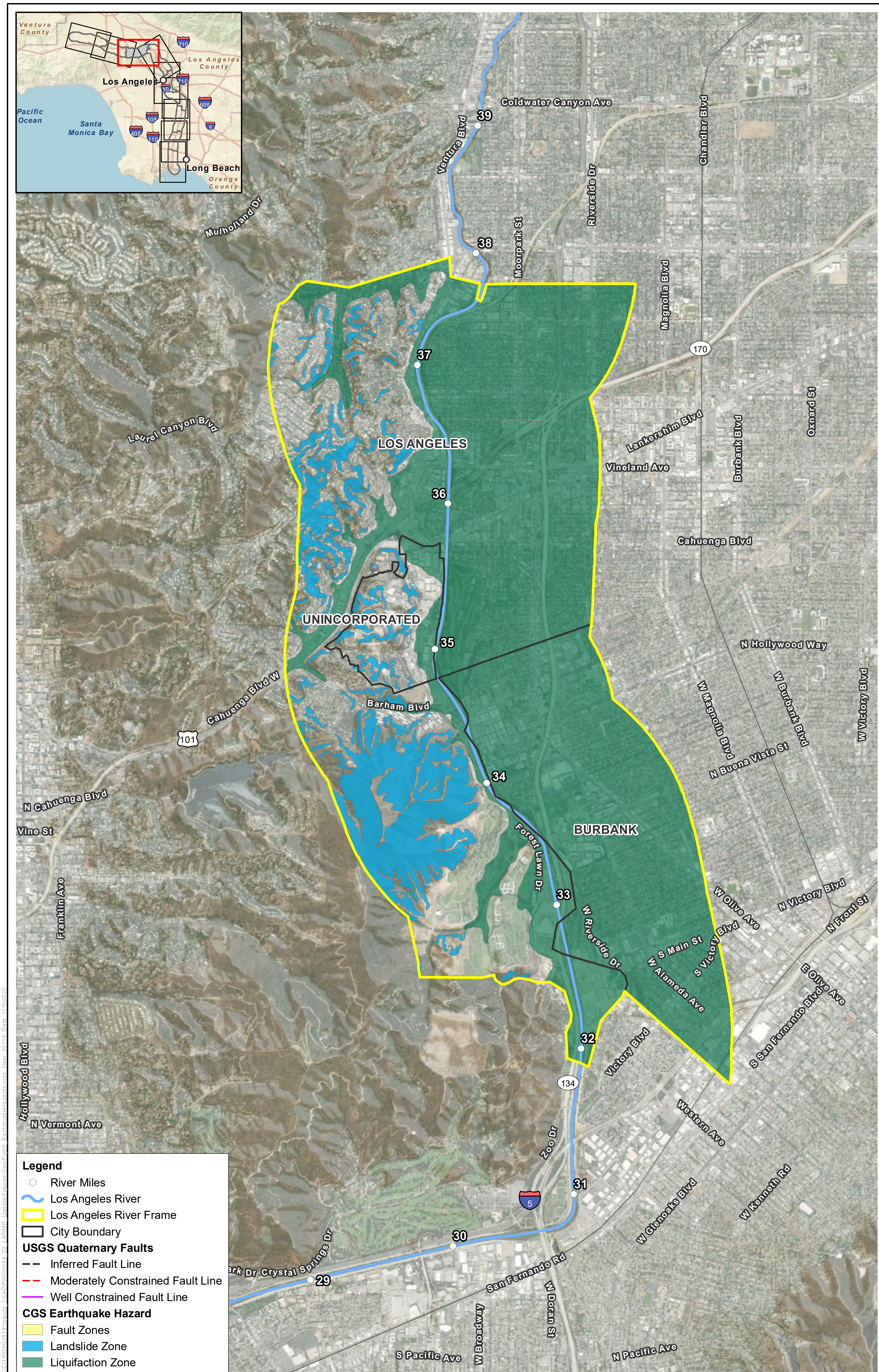
1:39,000

Source: County of Los Angeles; ESRI

Frame 6 - Narrows
Earthquake Hazard Zones



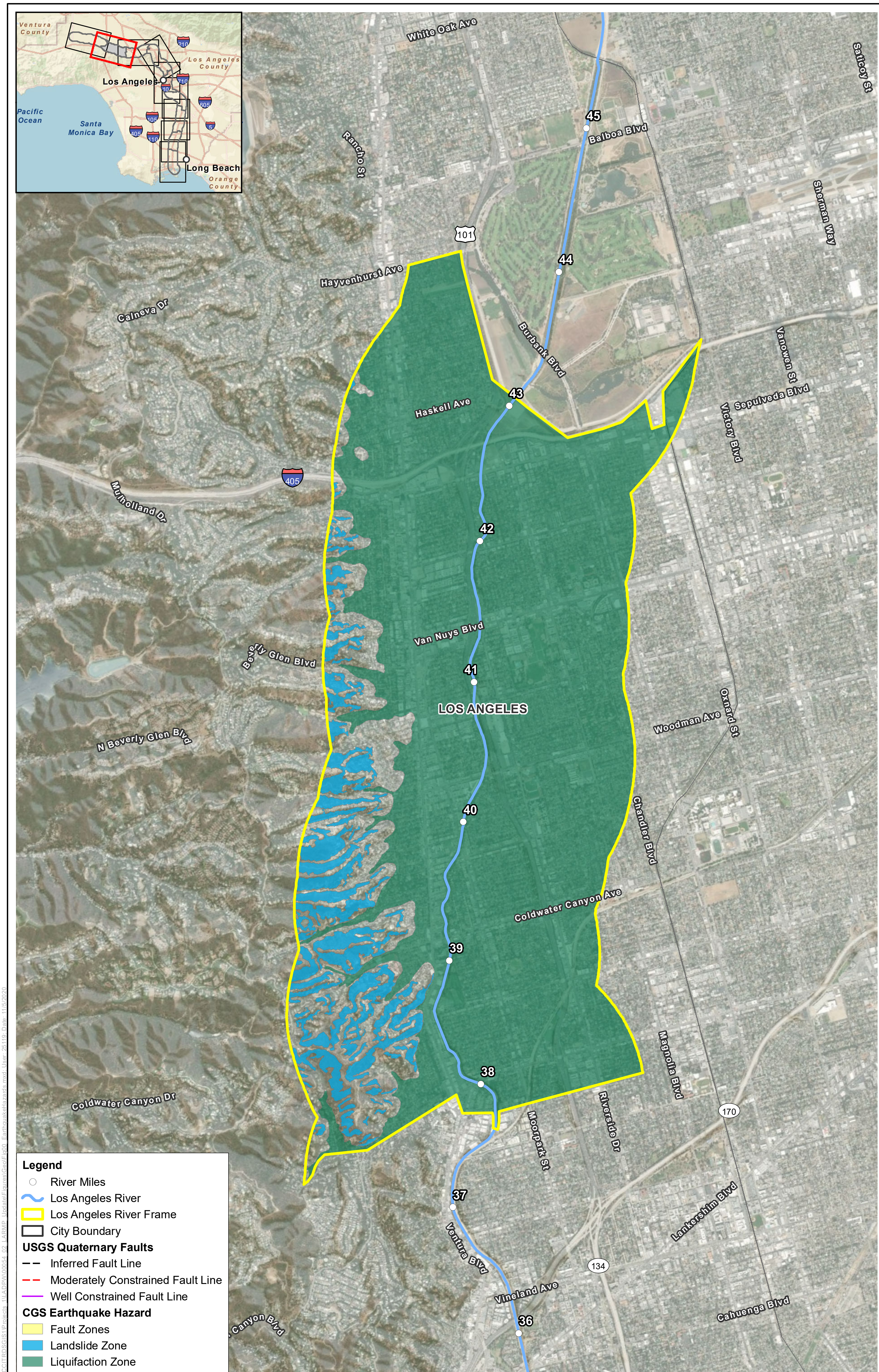
N

0 1,625 3,250 Feet

1:39,000

Source: County of Los Angeles; ESRI

Frame 7 - East Valley
Earthquake Hazard Zones

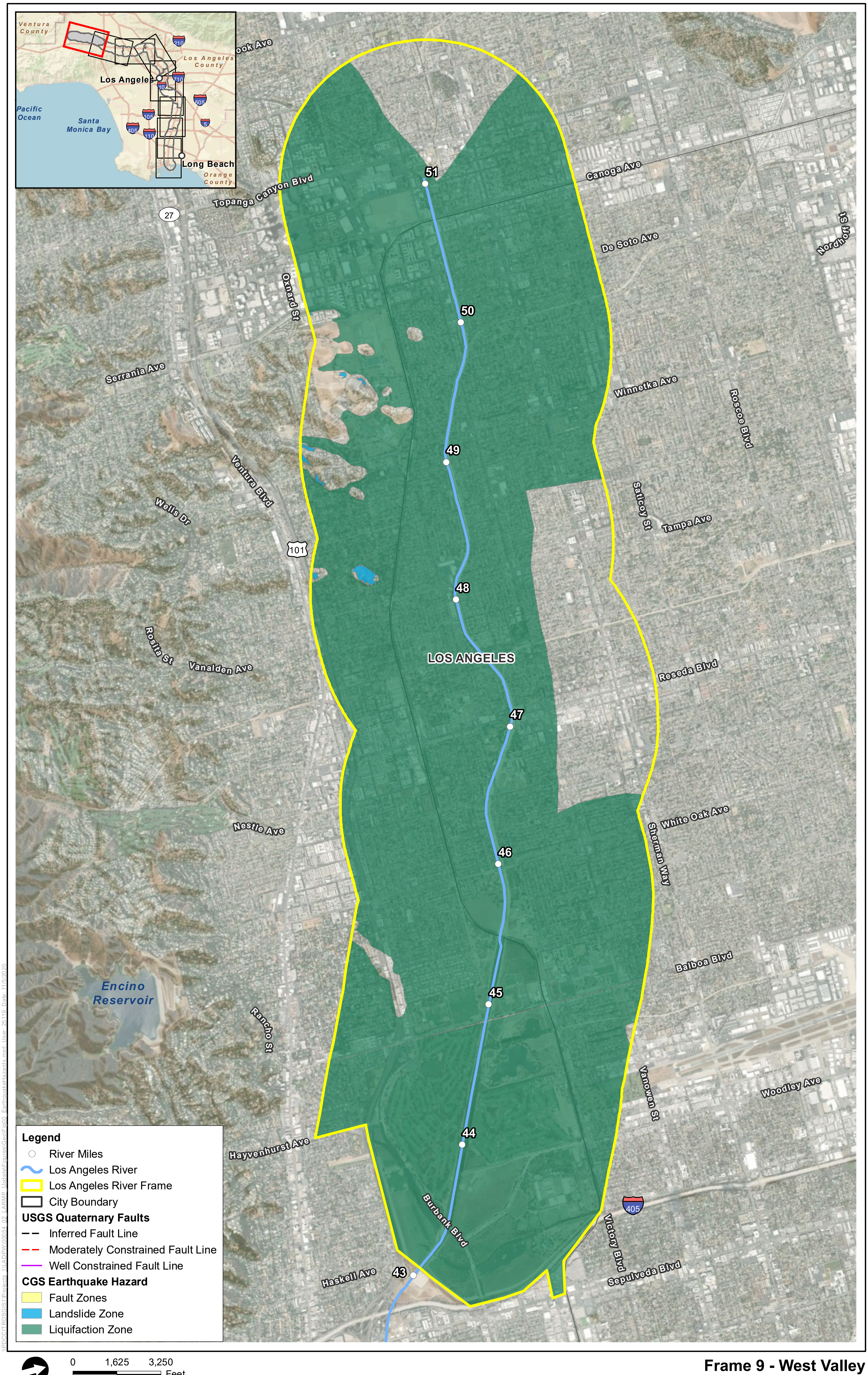


0 1,625 3,250 Feet
1:39,000

N

Source: County of Los Angeles; ESRI

Frame 8 - Mid Valley
Earthquake Hazard Zones



Frame 9 - West Valley
Earthquake Hazard Zones

Source: County of Los Angeles; ESRI

geographic area covered by the LA River, it is possible to encounter compressible soils in some areas.

Expansive soils are fine-grained soils (generally high-plasticity clays) that can undergo a significant increase in volume with an increase in water content, as well as a significant decrease in volume with a decrease in water content. Changes in the water content of highly expansive soils can result in severe distress for structures constructed on or against the soils. Given the geographic area covered by the LA River, it is possible to encounter expansive soils in some areas.

Paleontological Resources

Paleontology is the study of life forms of the past, especially prehistoric life forms, through the examination of plant and animal fossils. Paleontological resources represent a limited, non-renewable, and impact-sensitive scientific and educational resource. As defined in this PEIR, *paleontological resources* are the fossilized remains or traces of multi-cellular invertebrate and vertebrate animals and multi-cellular plants, including their imprints from a previous geologic period. Fossil remains such as bones, teeth, shells, and leaves are found in the geologic deposits (i.e., rock formations) where they were originally buried. Paleontological resources include not only the actual fossil remains, but also the specific locations where fossil remains have been collected, referred to as *collecting localities*, and geologic formations containing those localities.

A paleontological records search was conducted for the study area through the Los Angeles County Natural History Museum on July 20, 2020 (McLeod 2020). The results of the records search indicate that the entire study area contains geologic formations considered sensitive for paleontological vertebrate fossil resources. These deposits range in age from the youngest Quaternary period (2.6 million years ago to present) to the Middle Miocene period (15.97 million years ago). The sensitive sedimentary geologic deposits are generally buried beneath overlying younger alluvial deposits but, depending on location, setting, and previous development, these sensitive deposits can be at or near the existing ground surface. Younger alluvial deposits are not considered sensitive for containing significant paleontological resources because of their recent geologic age and lack of significant fossiliferous deposits; however, the lower zones of the overlying younger alluvial deposits have increased potential for containing significant vertebrate fossils and should be monitored. The depth ranges for the interfaces between geologic deposits is variable across the study area, ranging from the current ground surface to depths of more than 100 feet below ground surface (bgs), depending upon location.

The Impact Mitigation Guidelines Revisions Committee of the Society of Vertebrate Paleontology (SVP) Standard Guidelines include procedures for the investigation, collection, preservation, and cataloguing of fossil-bearing sites, including the designation of paleontological sensitivity (SVP 2010). These guidelines are widely accepted among paleontologists and followed by most investigators and identify the two key phases of paleontological resource protection as (1) assessment and (2) implementation. *Assessment* involves identifying the potential for a project site or area to contain significant nonrenewable paleontological resources that could be damaged or destroyed by project excavation or construction. *Implementation* involves formulating and applying measures to reduce such adverse effects.

For the assessment phase, SVP defines the level of potential as one of four sensitivity categories for sedimentary rocks: High, Undetermined, Low, and No Potential (SVP 2010).

- **High Potential**. Assigned to geologic units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered and to sedimentary rock units suitable for the preservation of fossils ("middle Holocene and older, fine-grained fluvial sandstones…fine-grained marine sandstones, etc. Paleontological potential consists of the potential for yielding abundant fossils, a few significant fossils, or recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data.").
- **Undetermined Potential**. Assigned to geologic units "for which little information is available concerning their paleontological content, geologic age, and depositional environment." In cases where no subsurface data already exist, subsurface site investigations can sometimes assess paleontological potential.
- **Low Potential**. Field surveys or paleontological research may allow determination that a geologic unit has low potential for yielding significant fossils (e.g., basalt flows). Mitigation is generally not required to protect fossils.
- **No Potential**. Some geologic units have no potential to contain significant paleontological resources, such as high-grade metamorphic rocks (e.g., gneisses and schists) and plutonic igneous rocks (e.g., granites and diorites). Mitigation is not required.

The main geologic units present across the study area are presented in Table 3.6-2, which includes the name of the geologic unit, the geologic age of the deposit, the sensitivity for significant paleontological resources according to the records search, and project frames where considered present (McLeod 2020). Table 3.6-3 provides a brief description of each geologic unit presented in Table 3.6-2.

Table 3.6-2. Geologic Units by Frame and Paleontological Sensitivity in the Study Area

Geologic Unit*	Geologic Unit Symbols*	Geologic Age	Paleontological Sensitivity	Fossil Types	Project Frame
Artificial Fill	Af	Modern	Low Potential	N/A	All frames
Landslide	Qls	Recent	Unknown	Unknown	6, 8
Younger Alluvium	Qg Qa, Qw, Qyf	Quaternary	Undetermined	Unknown	All frames
Older Quaternary Alluvium	Qoa, Qae Qof	Quaternary	High Potential	Non-marine vertebrates	1,2, 3, 4, 5, 6 7, 8
Old Lacustrine	Qol, Qop, Qops	Quaternary	Unknown	Unknown	1 and 2
Fernando Formation	Tfr	Pliocene	High Potential	Marine vertebrates	5
Unnamed Shale	Tud	Miocene	High Potential	Marine vertebrates	8, 7
Unnamed Shale	Tush, Tuss	Miocene	High Potential	Marine vertebrates	9, 5
Monterey Formation	Tm, Tmss Tmsh, Tmsl	Miocene	High Potential	Marine vertebrates	8, 7, 6 5

Geologic Unit*	Geologic Unit Symbols*	Geologic Age	Paleontological Sensitivity	Fossil Types	Project Frame
Upper Topanga Formation	Ttui,Ttusi, Ttus, Ttusc, Ttucg	Middle Miocene	High Potential	Marine vertebrates	8, 7
Middle Topanga	Tvb, Tts	Middle Miocene	Unknown	Unknown	8
Lower Topanga	Ttlc, Ttls	Middle to Early Miocene	Unknown	Unknown	8, 7
Dike Rocks	d	Pre-Tertiary?	No Potential	None	6 and 7
Granitic Rocks - Intrusive	qd, grd	Cretaceous	No Potential	None	6 and 7

Sources: McLeod 2020; Bedrossian et al. 2012; Saucedo et al. 2006; Campbell et al. 2014; Dibblee and Ehrenspeck 1989, 1991a, 1991b, 1991c, 1992a, 1992b; Note: all references to geologic units are based on Dibblee, unless otherwise noted.

Table 3.6-3. Description of Main Geologic Units from the Paleontological Analysis

Geologic Units	Symbol /Description	Age
Artificial Fill	Af – Resulting from human activity and construction; consisting of engineered and non-engineered placement derived from clay, silt, sand, and gravel	Modern
Younger Alluvium	Qg, Qa – Unconsolidated, generally friable, stream-deposited silt, sand, and gravels on floodplains, locally including related alluvial fans and streambeds; deposits clearly related to ongoing depositional processes Qw – Wash deposits Qvf – Young alluvial fan deposits, undivided (Bedrossian et al. 2012; Saucedo et al. 2006)	Quaternary to recent
Older Quaternary Alluvium	Qoa, Qae, – Unconsolidated to moderately indurated gravel, sand, and silt deposited on floodplains, locally including alluvial fans, and streambeds; deposits uplifted or otherwise removed from the locus of recent sedimentation; surfaces possibly dissected in varying degrees and can show moderately to well-developed pedogenic soils Qof – Old alluvial fan deposits, undivided (Bedrossian et al. 2012; Saucedo et al. 2006)	Quaternary to Late Pleistocene
Old Lacustrine	Qol, Qop and Qops – Old lacustrine, playa, and estuarine deposits (Bedrossian et al. 2012; Saucedo et al. 2006)	Quaternary to Pleistocene
Landslide Debris	Qls – Landslide debris	Quaternary

Geologic Units	Symbol /Description	Age
Fernando Formation	Tfr – Interbedded silty sandstone and massive pebble conglomerate of the Los Angeles Basin, primarily marine. In downtown Los Angeles, consolidated but crumbly gray to greenish-gray claystone-siltstone, sandy; vaguely bedded and locally fossiliferous.	Pliocene
Unnamed Shale Formation	Tush – Light gray claystone and siltstone, moderately bedded, crumbly where weathered Tud – White-weathering diatomaceous, clayey shale, thin bedded, soft, chalky to platy, semi-siliceous Tuss – Light gray sandstone, soft, friable, fine to medium grained	Late Miocene
Monterey Formation	Tm – White-weathering, thin bedded, platy, siliceous shale, dark brown where fresh; moderately hard; locally pocelaneous, brittle; in many places included thin interbeds of clay shale, siltstone and of light gray silty to fine grained sandstone Tmss – Light gray to tan semi-friable bedded sandstone, fine to medium grained; includes some inter-bedded siltstone and shale Tmsh – White-weathering, thin bedded, platy siliceous shale, hard to semi-chalky Tmsl – Marine siltstone, sandstone, and shale; includes white-weathering, thin bedded, platy siliceous shale, hard to semi-chalky; some thin bedded, porcelaneous and silty; and includes semi-friable sandstone	Late Miocene
Upper Topanga Formation	Ttui – Tan-weathering, thin-bedded, platy, semi-siliceous shale Ttusi – Mostly gray, micaceous clay shale claystone, crumbly where weathered, and thin interbeds of light gray to tan semi-friable sandstone Ttus – Light gray to tan, moderately hard, bedded sandstone; locally pebbly Ttusc – Light gray massive sandstone with pebble-cobble conglomerate Ttucg – Light gray conglomerate of pebbles and cobbles of granitic and metaporphryitic rocks and of subangular dense black andesite in soft sandy matrix	Middle Miocene
Middle Topanga	Tvb – Basaltic volcanic rocks; dark gray to black, fine grained, massive to locally vesicular and/or pillowed; composed of mafic minerals and plagioclase feldspar Tts – Dark gray sandstone of basaltic grains	Middle Miocene
Lower Topanga	Ttlc – mostly gray cobble conglomerate of granite and some metavolcanic detritus, locally sandstone matrix Ttls – Tan, moderately hard, thick-bedded arkosic sandstone	Early Miocene
Dike Rocks	d – Dark gray, fine-grained andesitic rocks composed of mafic materials; intrusive	Pre-Tertiary

Geologic Units	Symbol /Description	Age
Granitic Rocks - Intrusive Igneous Rocks	qg, grd – Exposures of intrusive igneous rocks do not contain recognizable fossils	Cretaceous

Sources: McLeod 2020; Bedrossian et al. 2012; Saucedo et al. 2006; Dibblee and Ehrenspeck 1989, 1991a, 1991b, 1992a, 1992b

Thirty-two previously recorded paleontological localities were identified in the study area, which identify areas where fossil-bearing deposits are located and where fossils were collected, analyzed, and curated. Twenty-three localities are adjacent to the ***study area*** and provide evidence for the presence of underlying sensitive geologic deposits with the potential to extend into the study area.

Seven of the nine frames contain previously recorded localities; however, all frames are considered sensitive for paleontological resources, due to the presence of fossil-bearing deposits that could be at the surface or buried at variable depths across each frame area. Table 3.6-4 details the previously recorded localities and the associated study area frames. The information from Table 3.6-4 is summarized by frame in the discussion below.

Table 3.6-4. Previously Recorded Paleontological Localities by Frame in the Study Area

Locality Number (LACM)	Depth (in approximate feet below surface)	Geologic Unit	Frame	In/Out[1] of Study Area
1144, 6896	48–100	Older Quaternary Alluvium	1	In
1021, 1022, 1165, 3245, 3319, 3382, 4129, 1919	5–37	Older Quaternary Alluvium	2	Out
1295, 1344, 3266, 3365, 4206	15	Older Quaternary Alluvium	3	Out
7701, 7702	11–34	Older Quaternary Alluvium	4	In
1023, 2032	20–35	Older Quaternary Alluvium	5	In
1755	43	Older Quaternary Alluvium	5	Out
3882, 7507	100	Monterey Formation	5	In
5961, 7990	Various	Monterey Formation	5	Out
3868, 4726, 6971 7730	Various	Fernando Formation	5	Out
1880, 4967	Various	Monterey Formation	6	In
342	14	Older Quaternary	6	Out
1084, 6969	Various	Upper Topanga Formation	7	In
6306, 6385, 6386, 6970	40–80	Older Quaternary Alluvium	7	In
1084, 6969	Various	Upper Topanga Formation	7	In
6306, 6385, 6386, 6970	40–80	Older Quaternary Alluvium	7	In
1229, 1230, 7020	Various	Unnamed Shale Formation	8	In
326	Various	Monterey Formation	8	In
3263, 6208	20	Older Quaternary Alluvium	8	In

Locality Number (LACM)	Depth (in approximate feet below surface)	Geologic Unit	Frame	In/Out[1] of Study Area
3173, 5125, 5657, 6021	Various	Unnamed Shale Formation	9	In
1213, 5878, 3822	75–100	Older Quaternary Alluvium	9	Out

Sources: McLeod 2020; Bedrossian et al. 2012; Saucedo et al. 2006; Campbell et al. 2014; Dibblee and Ehrenspeck 1989, 1991a, 1991b, 1992a, 1992b

[1] Refers to areas outside of the study area boundary but in the study area vicinity.

LACM = Los Angeles County Natural History Museum

Project Study Area Setting

Frame 1

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 1 is identified as Urban land-Metz-Pico complex. The soil unit is composed of well-drained, discontinuous human-transported material over mixed alluvium derived from granite and/or sedimentary rock.

Geologic Setting

Frame 1 includes portions of the City of Long Beach and the City of Los Angeles. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 1.

City of Long Beach

The City of Long Beach is on the coastal margins of the Los Angeles Basin, which is underlain by more than 15,000 feet of stratified sedimentary rocks of marine origin. Low areas now occupied by the LA and San Gabriel Rivers represent channels that ancestral rivers cut deeply into marine sediments during the lower sea level stand of the last ice age in late Pleistocene time. Over the past 17,000 years, the rivers have filled these channels to their present levels with relatively unconsolidated sand, silt, and gravel.

Dredging and landfill operation associated with construction of recreational and harbor facilities has highly modified low-lying coastal areas, especially along the seaward portions of the ancestral LA and San Gabriel Rivers (City of Long Beach 1988).

Faulting and Seismicity

The most significant active fault within the City of Long Beach is the Newport–Inglewood fault. According to the *City of Long Beach General Plan*'s Seismic Safety Element, this fault system is considered active: rupture along one of the branches of the Newport–Inglewood fault produced the 1933 Long Beach earthquake. Rupture on another segment of this fault zone caused the 1920 Inglewood earthquake. The Palos Verdes fault is another significant fault near the city. It travels along the northern edge of the Palo Verdes Hills and trends offshore through the Los Angeles Harbor. According to the *City of Long Beach General Plan*'s Seismic Safety Element, the Palos Verdes fault, also believed to be active, is capable of producing severe seismic shaking within the city (City of Long Beach 1988). It is possible that some sites could be within a California EFZ, which is a regulatory area around an active fault.

Newport–Inglewood Fault

The Newport–Inglewood fault is a right-lateral wrench fault system consisting of a series of en-echelon fault segments and folds. Topographic highs along the zone are surface expressions of individual faulted anticlinal structures; the faults and folds act as groundwater barriers and, at greater depths, form petroleum traps. Active or potentially active faults of the Newport–Inglewood fault zone within the city's boundaries include the Cherry Hill, Northeast Flank, and Reservoir Hill faults (City of Long Beach 1988).

Palos Verdes Fault

Within the City of Long Beach, the Palos Verdes fault lies immediately offshore and is one of several major northwest-trending faults in the region that is tectonically associated with the northwest-trending San Andreas fault system. Most of the mapped length of the Palos Verdes fault is offshore of Southern California, extending northwestward from Lasuen Knoll into San Pedro Bay, through Los Angeles Harbor, across the northern front of the Palos Verdes Hills, and into Santa Monica Bay. The Palos Verdes fault is in the same tectonic environment and nearly parallel to other active faults, such as the Newport–Inglewood, Elsinore, and San Andreas fault zones (City of Long Beach 1988). .

Surface Rupture

The LA River footprint crosses the Newport–Inglewood fault within the City of Long Beach (Figure 3.6-1 and Figure 3.6-2) and, although individual projects are not known at this time, it is possible that some sites could be within a California EFZ. If *2020 LA River Master Plan* projects are constructed in these areas, they could be subject to surface rupture. Figure 3.6-1 depicts the Newport–Inglewood fault zone in relation to the LA River corridor.

Ground Motion

Earthquake events from one of the regional active or potentially active faults within the city could result in strong ground shaking, which could affect sites along the LA River in the area. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions.

Secondary Seismic Effects

According to Plate 7 of the *City of Long Beach General Plan*, Seismic Safety Element, liquefaction potential varies from significant to minimal on the western portion of the city, including where the LA River is located (Figure 3.6-1). In addition, other secondary seismic conditions, such as ground rupture, lurching, and lateral spreading, can occur in areas prone to liquefaction.

In saturated granular soils, built-up water pressure between grains may lead to soil settlement after an earthquake. Areas most susceptible to settlement in the city are the same as those described with potential for liquefaction.

Generally speaking, slopes within the city are not high or steep, and slope instability historically has not been a significant problem. However, according to the general plan Seismic Safety Element, some small portions of the city have been identified as being prone to slope instability, including some areas near the LA River footprint (east of the Interstate [I-] 405 and I-710 connection).

City of Los Angeles

The City of Los Angeles covers a large geographic area, as far south as the community of San Pedro, as far north as the community of Sylmar, and as far west as the Pacific Ocean and Canoga Park to the northwest. Given their geographic proximity to each other and the fact that the City of Los Angeles covers such a large area, geologic conditions among the City of Los Angeles and the rest of the jurisdictions are expected to overlap with each other to some extent and are not expected to vary significantly.

The City of Los Angeles is between the northwestern end of the Peninsular Ranges geomorphic province and extends to a portion of the Transverse Ranges geomorphic province along the Santa Monica Mountains and Hollywood Hills (the Santa Monica Mountains and Hollywood Hills divide the City of Los Angeles into northern and southern portions). The Peninsular Ranges province, which encompasses an area that extends from the Transverse Ranges province, south to the Mexican border, and beyond to the tip of Baja California, is characterized by northwest-trending mountain range blocks separated by similarly northwest-trending faults. The Transverse Ranges are a distinctive unit of east- to west-trending faults and mountain ranges with intervening valleys in Santa Barbara, Ventura, Los Angeles, and San Bernardino Counties, rotated into their current configuration due to a left bend in the San Andreas fault. Associated compression of the region has resulted in folding, reverse/thrust faulting, and uplift of the province (Ninyo and Moore 2018).

Much of the Los Angeles area is composed of low-lying areas comprising the Los Angeles Basin and San Fernando Valley (the Los Angeles Basin and San Fernando Valley are discussed in detail above under *Regional Setting*). Los Angeles lies on a hilly coastal plain with the Pacific Ocean as its southerly and westerly boundaries. The city stretches west to the Santa Monica Mountains, northwest beyond the Hollywood Hills, and is bounded to the north by the San Gabriel Mountains. Numerous canyons and valleys characterize the area.

Faulting and Seismicity

The City of Los Angeles is in a high-seismicity region with numerous local faults. Faults with the highest likelihood to affect the City of Los Angeles are the Newport–Inglewood, Palos Verdes, Puente Hills, San Andreas, and Santa Monica faults (City of Los Angeles Emergency Management Department 2018). Brief descriptions of the Newport–Inglewood and Palos Verdes faults are presented above under the *City of Long Beach*.

Puente Hills

The Puente Hills fault, also known as the Puente Hills thrust system, is an active geological fault that runs about 25 miles in three discrete sections from the Puente Hills region in the southeast to just south of Griffith Park in the northwest. The fault is known as a blind thrust fault due to the lack of surface features normally associated with thrust faults.

San Andreas

The San Andreas fault is a continental transform fault that extends roughly 800 miles through California. It forms the tectonic boundary between the Pacific Plate and the North American Plate, and its motion is right-lateral strike-slip (horizontal). The fault divides into three segments, each with different characteristics and a different degree of earthquake risk, the most significant being the southern segment, which passes within about 35 miles of Los Angeles.

Santa Monica

The Santa Monica fault is one of several northeast- to southwest-trending, north-dipping, reverse faults that extend through the Los Angeles metropolitan area for approximately 50 miles.

Surface Rupture

The Newport–Inglewood and Hollywood fault zones cross the LA River footprint within the City of Los Angeles; however, this occurs within Frame 6. If *2020 LA River Master Plan* projects are constructed in these areas, they could be subject to surface rupture. Figure 3.6-6 depicts the Newport–Inglewood and Hollywood fault zones in relation to the LA River corridor.

Ground Motion

The primary seismic hazard in the City of Los Angeles is potential for ground shaking originating at the aforementioned faults. As *2020 LA River Master Plan* projects can occur anywhere along the study area, seismic shaking originating from any of the faults could affect project implementation.

Secondary Seismic Conditions

According to CGS's *Earthquake Zones of Required Investigation*, portions of the City of Los Angeles are within a liquefaction zone. See Figures 3.6-5 through 3.6-9 for liquefaction zones within the City of Los Angeles. In addition, areas within the City of Los Angeles near Elysian Park, Glendale, and Burbank are in landslide zones (California Department of Conservation 2019). Figures 3.6-6 through 3.6-9 depict areas that are generally susceptible to landslides.

Paleontological Resources

Frame 1 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formation in Frame 1 is the Older Quaternary Alluvium geologic unit. The overlying Younger Alluvium, generally exposed at the ground surface across Frame 1, is not considered sensitive for significant paleontological resources. Two previously recorded paleontological localities have been recorded in Frame 1 at depths ranging from 48 to 100 feet bgs.

Frame 2

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 2 is identified as Urban land-Metz-Pico complex. The soil unit is composed of well-drained, discontinuous human-transported material over mixed alluvium derived from granite and/or sedimentary rock.

Geologic Setting

Frame 2 includes portions of the Cities of Carson, Compton and Long Beach. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 2.

City of Carson

The City of Carson is underlain by Holocene-age alluvial deposits consisting of poorly consolidated sand, silt, clay, and gravel.

Faulting and Seismicity

The Newport–Inglewood and Palos Verdes faults, as described above for the City of Long Beach, are considered active and capable of generating earthquakes that could affect the City of Carson. The following faults could also affect the City of Carson.

Avalon–Compton Fault Zone

The Avalon–Compton fault branch, part of the Newport–Inglewood fault zone, is the only active fault in the City of Carson (City of Carson 2004). Historically, the Avalon–Compton fault/regional shear zone has moderate to high seismic activity with numerous earthquakes greater than Richter[1] magnitude 4.0 (USGS 2020).

Surface Rupture

The only active fault within the city limits is the Avalon–Compton fault branch. Although individual projects are not known at this time, it is possible that some sites could be within a California EFZ and experience surface rupture. Figure 3.6-2 depicts the Newport–Inglewood fault zone footprint in relation to the LA River.

Ground Motion

Ground motion within the City of Carson could be caused by any of the active or potentially active faults within or near the project area. The Newport–Inglewood (via Avalon Compton branch) or nearby faults such as Whittier, Santa Monica, and Palos Verdes faults are the active faults most likely to cause high ground accelerations in the city.

Secondary Seismic Conditions

The Newport–Inglewood fault zone is a potential source of ground motion, and liquefaction could occur in the city (a significant portion of the city has been designated as potential liquefaction area). Due to existing conditions in the city, particularly in the alluvial and former slough areas, there is the possibility that liquefaction could affect buildings and/or other structures in the event of an earthquake (City of Carson 2004). Liquefaction zones are identified in Figure 3.6-2.

Given the variation of the alluvial soils underlying Carson, differential settlement could occur as a result of an earthquake. Areas most susceptible to settlement in the city are the same as those described with potential for liquefaction. In addition, other secondary seismic conditions such as ground cracking, lurching, and lateral spreading can occur in areas prone to liquefaction.

Due to lack of significant elevation changes in the city, slope instability in Carson is limited to the slopes adjacent to the flood management channels that intersect the city. The loose, unconsolidated nature of the sediments, exposed in slopes that are not faced with concrete, may cause the slopes to be surficially unstable (City of Carson 2013).

City of Compton

Compton is underlain by alluvial deposits in the region consisting primarily of sand, silt, and gravel, and, to a lesser extent, clay.

[1] The Richter magnitude scale measures the magnitude of an earthquake as determined from the logarithm of the amplitude of waves recorded by seismographs.

Faulting and Seismicity

The Newport–Inglewood fault is the only active fault within the City of Compton. The Newport–Inglewood fault (via the Compton branch) runs through the southwest corner of Compton. The fault runs northwest to southeast between Central Avenue and Avalon Boulevard, crossing Rosecrans Avenue, Compton Boulevard, Alondra Boulevard, Walnut Street, and Artesia Boulevard.

Surface Rupture

The Newport–Inglewood fault extends through Compton and, in the event of an earthquake, the city could be subject to surface rupture or ground breakage along the surface of the fault (City of Compton 2011). However, the Newport–Inglewood fault zone is in the western portion of the city, away from the LA River. Figure 3.6-2 depicts the Newport–Inglewood footprint in relation to the LA River.

Ground Motion

Ground motion within the City of Compton could be caused by the Newport–Inglewood fault or any of the previously described active or potentially active regional faults capable of generating strong ground motion.

Secondary Seismic Conditions

A significant secondary seismic risk in Compton is liquefaction. Historical high groundwater in Compton ranges from 20 feet west of Compton Creek to 8 feet near Compton College, north to the boundaries of the city. Portions of the City of Compton within Frame 2 are within a liquefaction zone (Figure 3.6-2).

Compton's soil is low in clay content, reducing the subsidence caused by clay soil compaction. According to the *Draft Compton General Plan 2030*, there is a potential for slope failure along the southern banks of Compton Creek, near Artesia Boulevard (City of Compton 2011).

Paleontological Resources

Frame 2 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formation in Frame 2 is the Older Quaternary Alluvium geologic unit. The overlying Younger Alluvium geologic unit, generally exposed at the ground surface, is not considered sensitive for significant paleontological resources. Eight previously recorded paleontological localities have been recorded in the vicinity of Frame 2 of the study area at depths ranging from 5 to 37 bgs.

Frame 3

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 3 is identified as Urban land-Metz-Pico complex. The soil unit is composed of well-drained, discontinuous human-transported material over mixed alluvium derived from granite and/or sedimentary rock.

Geologic Setting

Frame 3 includes portions of the Cities of Compton, Cudahy, Downey, Lynwood, Paramount, and South Gate. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 3.

City of Cudahy

The City of Cudahy is within the South Gate Quadrangle and the Los Angeles Basin (a geologic description of the Los Angeles Basin is provided under *Regional Setting*). The South Gate Quadrangle is covered by alluvial sediments of Quaternary age. Older alluvial fan sediments of Pleistocene age are associated with the Montebello Hills and Dominguez Hills. Elsewhere across most of the quadrangle are the younger alluvial fan sediments of Holocene and late Pleistocene age. The sediments described consist of varying proportions of sand, gravel, silt, and clay.

Faulting and Seismicity

There are no faults that transect Cudahy. However, as previously described, seismic activity of regional faults can have effects within the city.

Ground Motion

As with all of Southern California, Cudahy lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Cudahy, surface rupture is not likely to occur.

Secondary Seismic Conditions

Due to shallow groundwater and soil characteristics, the entire City of Cudahy is within a liquefaction hazard zone. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

City of Downey

The City of Downey is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting described for Cudahy is applicable to the City of Downey.

Faulting and Seismicity

There are no faults that transect Downey. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

As with all the cities in Southern California, Downey lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Downey, surface rupture is not likely to occur.

Secondary Seismic Conditions

Downey has a combination of silts and sands and a relatively high water table, conditions that are conducive for liquefaction. Therefore, the entire City of Downey is within a liquefaction hazard zone. Areas susceptible to settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

City of Lynwood

The City of Lynwood is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting described for Cudahy applies to the City of Lynwood.

Faulting and Seismicity

There are no faults that transect Lynwood. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

As with all the cities in Southern California, Lynwood lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Lynwood, surface rupture is not likely to occur.

Secondary Seismic Conditions

Lynwood has historically shallow groundwater conditions along with subsurface characteristics that are conducive for liquefaction. As such, the entire City of Lynwood is within a liquefaction hazard zone. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

No areas have been designated as zones of required investigation for earthquake-induced landslides within the city. However, the potential for landslides may exist locally, particularly along streambanks margins of drainage channels and similar settings where steep banks or slopes occur.

City of Paramount

The City of Paramount is also within the South Gate Quadrangle and the Los Angeles Basin. Therefore, geologic setting information described for Cudahy applies to the City of Paramount.

Faulting and Seismicity

There are no faults that transect Paramount. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Paramount lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Paramount, surface rupture is not likely to occur.

Secondary Seismic Conditions

Shallow groundwater conditions, along with subsurface soils characteristics underlying the city, create conditions conducive for liquefaction. As such, the entire City of Paramount is within a liquefaction hazard zone. Areas most susceptible to seismically induced settlement in the city are the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

City of South Gate

The City of South Gate is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting i described for Cudahy applies to the City of South Gate.

Faulting and Seismicity

There are no faults that transect South Gate. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

South Gate lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect South Gate, surface rupture is not likely to occur.

Secondary Seismic Conditions

The alluvial deposits underlying the City of South Gate are deposited by a river as sand, silt, and/or gravel. This type of deposit can be susceptible to liquefaction. As such, the entire City of South Gate is within a liquefaction hazard zone. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction (City of South Gate 2017).

There are no designated seismically induced landslide zones in South Gate due to its relatively flat topography. However, surficial failures are considered a possibility along the LA River, drainage channels, or other areas where steepened slopes are found.

Paleontological Resources

Frame 3 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formation in Frame 3 is the Older Quaternary Alluvium geologic unit. The overlying Younger Alluvium geologic unit, generally exposed at the ground surface in Frame 3, is not considered sensitive for significant paleontological resources. Five previously recorded paleontological localities have been recorded in the vicinity of the study area at an approximate depth of 15 bgs.

Frame 4

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 4 is identified as Urban land, commercial. The soil unit is characterized as a manufactured layer.

Geologic Setting

Frame 4 includes portions of the cities of Bell, Bell Gardens, Commerce, Huntington Park, Maywood, and Vernon. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 4.

City of Bell

The City of Bell is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting described for the City of Cudahy is applicable to the City of Bell.

Faulting and Seismicity

There are no faults that transect Bell. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Bell lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Bell, surface rupture is not likely to occur.

Secondary Seismic Conditions

Bell has areas of low to high potential for liquefaction. However, the vast majority of the city is identified as having a high liquefaction potential, including the area adjacent to the LA River. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions such as ground cracking, lurching, and lateral spreading can occur in areas prone to liquefaction.

Bell has relatively flat topography; therefore, hazards associated with slope instability are considered unlikely. The Bandini oil field is under the Cheli Industrial Area of the city and could present subsidence hazards due to extensive oil pumping and withdrawal conducted in this area.

City of Bell Gardens

The City of Bell Gardens is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting described for the City of Cudahy is applicable to the City of Bell Gardens.

Faulting and Seismicity

There are no faults that transect Bell Gardens. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Bell Gardens lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Bell Gardens, surface rupture is not likely to occur.

Secondary Seismic Conditions

Bell Gardens is on alluvial deposits (consisting of silt, gravel, sand, and clay) from the LA River. These soils are highly susceptible to liquefaction. As such, Bell Gardens is identified as an area with high to moderate risk for liquefaction. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spread, can occur in areas prone to liquefaction.

Bell Gardens has a relatively flat topography, and hazards associated with seismically induced landsliding are considered unlikely.

City of Commerce

The City of Commerce is primarily within the South Gate Quadrangle, with a portion within the Los Angeles Quadrangle; therefore, setting information related to the South Gate Quadrangle described for Cudahy also applies here.

The Los Angeles Quadrangle lies within the south-central part of the Transverse Ranges geomorphic province. The southeastern corner of the Los Angeles Quadrangle includes the northern part of the Los Angeles Basin. The northwestern quarter of the Los Angeles Quadrangle includes the eastern part of the Ventura Basin and its southeastern extension, the San Fernando Basin. These basins were the sites of very thick accumulations of marine sediments in the late Miocene and Pliocene.

Faulting and Seismicity

There are no faults that transect Commerce. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Commerce lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Commerce, surface rupture is not likely to occur.

Secondary Seismic Conditions

According to the *City of Commerce 2020 General Plan* Safety Element (City of Commerce 2008), the city would undergo noticeable ground shaking in the event of an earthquake; however, the city would not likely be exposed to secondary seismic hazards, such as seismically induced ground settlement and landsliding. According to CGS's *Earthquake Zones of Required Investigation*, the areas closest to the LA River are in a liquefaction-prone area (California Department of Conservation 2019).

City of Huntington Park

The City of Huntington Park is within the South Gate Quadrangle and the Los Angeles Basin. Therefore, the geologic setting information described for the South Gate Quadrangle under the City of Cudahy above is applicable to the City of Huntington Park.

Faulting and Seismicity

There are no faults that transect Huntington Park. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Huntington Park lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Huntington Park, surface rupture is not likely to occur.

Secondary Seismic Conditions

According to the *City of Huntington Park 2030 General Plan*'s Health and Safety Element, a study of earthquake hazards by USGS indicated that a majority of the city is subject to liquefaction. According to CGS's *Earthquake Zones of Required Investigation*, the city as a whole is in a liquefaction-prone area. Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

City of Maywood

The City of Maywood is within the South Gate Quadrangle and the Los Angeles Basin (a geologic description of the Los Angeles Basin is described under *Regional Setting*). Therefore, the geologic setting described for the South Gate Quadrangle under the City of Cudahy above applies to Maywood.

Faulting and Seismicity

There are no faults that transect Maywood. However, seismic activity along nearby faults can have effects within the city.

Ground Motion

Maywood lies within a seismically active region and is subject to strong ground shaking from earthquakes generated by regional faults.

Surface Rupture

As no known active faults transect Maywood, surface rupture is unlikely to occur.

Secondary Seismic Conditions

According to CGS's *Earthquake Zones of Required Investigation*, the city as a whole is in a liquefaction-prone area. Areas susceptible to settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction (California Department of Conservation 2019).

City of Vernon

The City of Vernon is partially within the South Gate and Los Angeles Quadrangles. Setting information described for cities within the South Gate and Los Angeles Quadrangles also applies here, as variation is not expected to be significant. The South Gate Quadrangle is described under the City of Cudahy and the Los Angeles Quadrangle is described under the City of Commerce, above.

Faulting and Seismicity

There are no faults that transect Vernon. However, seismic activity on nearby faults can have effects within the city.

Ground Motion

Vernon lies within a seismically active region and is subject to strong ground shaking from earthquakes generated on regional faults.

Surface Rupture

As no known active faults transect Vernon, surface rupture is not likely to occur.

Secondary Seismic Conditions

Liquefaction is not considered a significant hazard within the City of Vernon; however, some areas of the city are designated as susceptible to liquefaction hazard, particularly the southern and southeastern portions of the city (California Department of Conservation 2019). Areas susceptible to seismically induced settlement can be the same as those described with potential for liquefaction. In addition, other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

Paleontological Resources

Frame 4 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formation in Frame 4 is the Older Alluvial geologic unit. The overlying Younger Alluvium geologic unit, generally exposed at the ground surface in Frame 4, is not considered sensitive for significant paleontological resources. Two previously recorded paleontological localities have been recorded in Frame 4 of the study area at depths ranging from 11 to 34 bgs.

Frame 5

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 4 is identified as Urban land, commercial. The soil unit is characterized as a manufactured layer.

Frame 5 includes only the City of Los Angeles, which is described under Frame 1.

Paleontological Resources

Frame 5 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formations in Frame 5 include Older Quaternary Alluvium, the Fernando Formation, and the Monterey Formation. The overlying Younger Alluvium, generally exposed at the ground surface, is not considered sensitive for significant paleontological resources. Five previously recorded paleontological localities have been recorded in Frame 5. Three of these localities are associated with the Monterey Formation and two with the Older Quaternary geologic unit and were recovered at varying depths.

Six previously recorded localities have been recorded in the vicinity Frame 5 of the study area. Four were associated with the Fernando Formation, one with the Monterey Formation, and one with the Older Quaternary geologic unit and were recovered at varying depths.

Frame 6

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 6 is identified as Urban land-Palmview-Tujunga complex. The soil unit is composed of well-drained, discontinuous human-transported material over alluvium derived from granite.

Geologic Setting

Frame 6 includes portions of the Cities of Glendale and Los Angeles. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 6.

City of Glendale

According to the *City of Glendale General Plan*'s Safety Element (2003), the City of Glendale is at the boundary between two of Southern California's geomorphic provinces (Transverse and Peninsular) in an area that is being compressed by geological forces associated with movement on tectonic plates. Geologic units in the Glendale area have fine-grained components that are moderately to highly expansive, typically along faults and fracture zones. Fine-grained sediments also occur along the southern portion of the city in the distal portions of the alluvial fans. These fine-grained units may not be present at the surface but may be exposed in the subsurface. The City of Glendale is within the Burbank Quadrangle. Soils in the Glendale area may have fine-grained components that are moderately to highly expansive, typically along faults and fracture zones, where the bedrock has been ground to a fine-grained, plastic material.

Faulting and Seismicity

According to the *City of Glendale General Plan* Safety Element, main faults in the Glendale area include the Sierra Madre, Verdugo, and Raymond faults. A portion of the Sierra Madre fault extends through Glendale and is zoned under the Alquist-Priolo Earthquake Fault Zoning Act. The Verdugo fault, which extends across the central portion of the city, is a left-lateral strike slip fault, similar to the Raymond fault, which is immediately south of the city. The trace of the Verdugo fault has been mostly obscured by development (City of Glendale 2003).

Ground Motion

The City of Glendale lies within a seismically active region and is subject to strong ground shaking from earthquakes generated on regional faults.

Surface Rupture

The Verdugo fault transects Glendale and underlies extensively developed portions of the city. Therefore, impacts related to fault rupture are possible within the city.

Secondary Seismic Conditions

Shallow groundwater levels have occurred historically in some portions of the City of Glendale, generally along the LA River drainage in the southwestern portion of the city and in the lower reaches of some of the canyons. Shallow groundwater has also been reported in the Verdugo Wash area, north of the Verdugo fault. According to CGS's *Earthquake Zones of Required Investigation,* the area of the city adjacent to the LA River is within a liquefaction zone (California Department of Conservation 2019). Areas susceptible to settlement can be the same as those described with potential for liquefaction. Other secondary seismic conditions, such as ground cracking, lurching, and lateral spreading, can occur in areas prone to liquefaction.

The City of Glendale's hillsides are vulnerable to slope instability due primarily to the fractured, crushed, and weathered condition of the bedrock and the steep terrain. Over-steepened slopes along the large drainage channels are also locally susceptible to slope instability. According to CGS's *Earthquake Zones of Required Investigation,* the southwestern portion of the city lies adjacent to an area prone to seismically induced landslides (also identified as a landslide zone by CGS), including where the LA River runs adjacent to and within the city (California Department of Conservation 2019).

Paleontological Resources

Frame 6 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formation in Frame 6 is the Monterey Formation geologic unit. The overlying Younger Alluvium geologic unit, generally exposed at the ground surface in Frame 6, is not considered sensitive for significant paleontological resources. Two previously recorded paleontological localities have been recorded in Frame 4 of the study area at varying depths. Intrusive igneous rocks are present at the surface of the vicinity of Frame 6, and these geologic deposits are not considered sensitive for paleontological resources.

Frame 7

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 7 is identified as Urban land-Palmview-Tujunga complex. The soil unit is composed of well-drained, discontinuous human-transported material over alluvium derived from granite.

Geologic Setting

Frame 7 includes portions of the Cities of Los Angeles and Burbank. The following contains a brief geologic setting along with seismic hazard conditions for each city within Frame 7.

City of Burbank

The Burbank area primarily consists of well-drained soils that formed in alluvium from granitic or related rock sources. Similar to the City of Glendale, the City of Burbank is within the Burbank Quadrangle. Therefore, the geologic setting described for the City of Glendale would be similar here.

Faulting and Seismicity

According to the *Burbank2035 General Plan* Safety Element, Burbank contains one active fault, the Verdugo fault, just south of the Verdugo Mountains and extending across the northern portion of the City of Burbank. Other faults in the area include the Sierra Madre and the Raymond faults.

Ground Motion

The City of Burbank lies within a seismically active region and is subject to strong ground shaking from earthquakes generated along the Verdugo fault and other Southern California regional faults.

Surface Rupture

The Verdugo fault transects Burbank. Therefore, impacts related to fault rupture are possible within the city. However, the Verdugo fault is in the northern portion of the city, beyond the Golden State Freeway (I-5) and away from the LA River footprint.

Secondary Seismic Conditions

Much of Burbank is atop soils susceptible to liquefaction, particularly in the areas west of I-5. According to CGS's *Earthquake Zones of Required Investigation,* the area of the city adjacent to the LA River is in a liquefaction zone (California Department of Conservation 2019). In addition, the southern tip of the city lies adjacent to an area prone to seismically induced landslides (also identified as a landslide zone), including within the study area.

Paleontological Resources

Frame 7 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formations in Frame 7 are the Older Quaternary Alluvium and Upper Topanga Formation geologic units. The overlying Younger Alluvium geologic unit, generally exposed at the ground surface in Frame 7, is not considered sensitive for significant paleontological resources. Six previously recorded paleontological localities have been recorded in Frame 7 of the study area at depths ranging from 40 to 80 feet bgs.

Frame 8

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 8 is identified as Urban land-Grommet-Ballona complex. The soil unit is composed of well-drained, discontinuous human-transported material over young alluvium derived from sedimentary rock.

Frame 8 includes only the City of Los Angeles, which is described under Frame 1.

Paleontological Resources

Frame 8 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formations in Frame 8 include the Monterey Formation, Unnamed Shale deposits, and Older Quaternary geologic units. The overlying Younger Alluvium, generally exposed at the ground surface, is not considered sensitive for significant paleontological resources. Six previously recorded paleontological localities have been recorded in Frame 8. Three of these localities are associated with the Unnamed Shale unit and one with the Monterey Formation, recovered at varying depths; two were recovered from the Older Quaternary Formation at depths ranging from 14 to 20 feet bgs.

Frame 9

Soils

According to the Natural Resources Conservation Service's Web Soil Survey, the primary soil unit found within Frame 8 is identified as Mocho-Urban land complex. The soil unit is composed of well-drained, young alluvium derived from sandstone and shale.

Frame 9 includes only the City of Los Angeles, which is described under Frame 1.

Paleontological Resources

Frame 9 contains geologic deposits that are sensitive for paleontological resources. The sensitive geological formations in Frame 9 include the Unnamed Shale and the Older Quaternary geologic units. The overlying Younger Alluvium, generally exposed at the ground surface across Frame 9, is not considered sensitive for significant paleontological resources. Four previously recorded paleontological localities associated with the Unnamed Shale have been recorded in Frame 9 and were recovered at varying depths.

Three previously recorded localities have been recorded in the vicinity of the study area near Frame 9. All three were associated with the Older Quaternary geologic unit and recovered at depths up to 100 feet bgs.

3.6.2.2 Regulatory

This section identifies laws, regulations, and ordinances that are relevant to the impact analysis of geology, soils, and paleontological resources in this PEIR.

Federal

Clean Water Act (Erosion Control)

The federal Clean Water Act (33 U.S. Code 1251 et seq.), formerly the Federal Water Pollution Control Act of 1972, was enacted with the intent of restoring and maintaining the chemical, physical, and biological integrity of the waters of the U.S. The Clean Water Act requires states to set standards to protect, maintain, and restore water quality through the regulation of point-source and certain nonpoint-source discharges to surface water. Such discharges are regulated by the National Pollutant Discharge Elimination System (NPDES) permit process (Clean Water Act Section 402). Projects that disturb 1 acre or more are required to obtain NPDES coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit), Order No. 2009-0009-DWQ. The Construction General

Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP), which includes best management practices (BMPs) to regulate stormwater runoff, including measures to prevent soil erosion.

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act was enacted in 1977 to "reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program." To accomplish this, the Earthquake Hazards Reduction Act established the National Earthquake Hazards Reduction Program, which significantly amended the program in November 1990, refining the descriptions of agency responsibilities, program goals, and objectives.

The program's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improvement of mitigation capacity; and accelerated application of research results. The National Earthquake Hazards Reduction Program designates the Federal Emergency Management Agency as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities. Programs under the National Earthquake Hazards Reduction Program help inform and guide planning and building code requirements such as emergency evacuation responsibilities and seismic code standards such as those to which the proposed Project would be required to adhere.

The Antiquities Act of 1906

The Antiquities Act of 1906 states that any person who appropriates, excavates, injures, or destroys any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the U.S., without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, upon conviction would be fined in a sum of not more than $500 or be imprisoned for a period of not more than 90 days, or both, at the discretion of the court. While the act does not specially address paleontological resources, the term *objects of antiquity* has been interpreted by the National Park Service, the Bureau of Land Management, the Forest Service, and other agencies to include fossils. Permits to collect fossils on federal lands are authorized under this act.

Title 23 U.S. Code Section 305

This statute amends the Antiquities Act of 1906 and allows for funding for mitigation of paleontological resources on projects funded by federal highway funds. The statute contemplates that "excavated objects and information are to be used for public purposes without private gain to any individual or organization" (*Federal Register* 46(19):9570).

National Registry of Natural Landmarks

The National Natural Landmarks Program (16 U.S. Code 461–467), established in 1962 under the authority of the Historic Sites Act of 1935, recognizes and encourages the conservation of outstanding examples of our country's natural history. Under the only natural areas program of national scope that identifies and recognizes the best examples of biological and geological features in both public and private ownership, National Natural Landmarks are designated by the Secretary of the Interior, with the owner's concurrence, as being of national significance, defined as being one of the best examples of a biological community or geological feature within a natural region of the U.S., including terrestrial communities, landforms, geological features and processes, habitats of native plant and animal species, or fossil evidence of the development of life (36 Code of Federal Regulations 62.2). The National Park Service administers the program and, if requested, assists National Natural Landmark owners and managers with the conservation of these important sites.

Paleontological Resources Preservation Act of 2009

The Paleontological Resources Preservation Act is part of the Omnibus Public Land Management Act of 2009 (Public Law 111-11, Title VI, Subtitle D). This act directs the Secretary of the Interior or the Secretary of Agriculture to manage and protect paleontological resources on federal land and develop plans for inventorying, monitoring, and deriving the scientific and educational use of such resources. It prohibits the removal of paleontological resources from federal land without a permit issued under this act, establishes penalties for violation of this act, and establishes a program to increase public awareness about such resources. The bill imposes criminal penalties for violating this act, which includes serving up to 10 years in prison if convicted.

State

Alquist-Priolo Earthquake Fault Zoning Act

The 1972 Alquist-Priolo Earthquake Fault Zoning Act requires the State Geologist to delineate EFZs along known active faults in California. The act also requires building setbacks to be established from the trace of an active fault. EFZs must meet the requirements of being "sufficiently active" (i.e., evidence of movement within the last approximate 11,000 years) and "well-defined" (i.e., detectable by a trained geologist). It is known that faults often rupture along a complex zone that may include the movement of multiple fault splays/strands rather than of a single fault strand. The EFZs are intended to be sufficiently wide enough on both sides of a known active fault trace to encompass unknown splays/strands of a fault. The purpose of the Alquist-Priolo Earthquake Fault Zoning Act is to prohibit new structures for human occupancy from being located on active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was passed in 1990 and went into effect in 1991. The act addresses issues related to earthquake hazards from non-surface fault rupture, including hazards related to liquefaction and seismically induced landslides. The purpose of the Seismic Hazards Mapping Act is to identify and map seismic hazards, intended for use by cities and counties when preparing the safety elements of their general plans, thereby encouraging land use management policies and regulations that will reduce damage from seismic hazards. The act has resulted in the preparation of maps that delineate liquefaction zones and earthquake-induced landslide zones of required investigation (California Department of Conservation 2019).

California Building Standards Code

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in the State of California. The State of California provides minimum standards for building design through the California Building Code (CBC), a component of the California Building Standards Code (codified under California Code of Regulations Title 24). The CBC regulates structural design, structural tests and inspections, and soils and foundations. The CBC applies to building design and construction in the State and is based on the federal Uniform Building Code, which is used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC, which has been modified for California conditions, contains numerous provisions that are more stringent than those in the Uniform Building Code because of California's seismic and environmental conditions. According to Section 1613 of the CBC, "[e]very structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, will be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7."

State of California Geological Survey

CGS (formerly the California Division of Mines and Geology) identifies earth resource issues that should be taken into consideration when evaluating a proposed project for geologic hazards, particularly related to earthquake damage. Consideration includes the potential for existing geologic conditions to affect a proposed project, as well as the potential for a proposed project to affect the existing geologic and soil conditions by creating or exacerbating a geologic hazard. CGS provides web-based applications that identify areas prone to geologic hazards (e.g., Landslide Inventory, Earthquake Zones of Required Investigation). CGS establishes regulations related to geologic hazards, including faulting, liquefaction, seismically induced landslides, and ground shaking, as they affect people and structures. These regulations include the Alquist-Priolo Earthquake Fault Zone Act and the Seismic Hazards Mapping Program. CGS also issues guidelines for the evaluation of geologic and seismic factors that may affect a project or that may be affected by a project. Each guideline provides checklists and outlines to ensure a comprehensive report of geologic and seismic conditions. Although not mandatory in all their detail, the guidelines aid in ensuring completeness of geologic and seismic studies conducted for a project.

California Building Code

The CBC consists of 11 parts that contain administrative regulations of the California Building Standards Commission and regulations of all State agencies that implement or enforce building standards. Local agencies must ensure that development in their jurisdictions comply with guidelines contained in the CBC. Cities and counties can, however, adopt building standards beyond those provided in the CBC.

Geologic resources and geotechnical hazards are governed primarily by local jurisdictions. Most local jurisdictions rely on the CBC for a basis of seismic design. All local jurisdictions must comply with regulations of the Alquist-Priolo Act and EFZ requirements of the State of California Department of Conservation.

Public Resources Code Section 5097.5

California Public Resources Code Section 5097.5 prohibits excavation or removal of any:

> …vertebrate paleontological site, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands and specifies that state agencies may undertake surveys, excavations, or other operations as necessary on publicly owned lands to preserve or record paleontological resources.

Public lands include those owned by or under the jurisdiction of the State or any city, county, district, authority, or public corporation or any agency thereof. Section 5097.5 states that any unauthorized disturbance or removal of archaeological, historical, or paleontological materials or sites on public lands is a misdemeanor.

Regional

Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit

On November 8, 2012, the Regional Water Quality Control Board adopted Order No. R4-2012-175 (NPDES Permit No. CAS004001) Waste Discharge Requirements for MS4 Discharges Within the Coastal Watersheds of Los Angeles County, Except Those Discharges Originating from the City of Long Beach MS4 (County MS4 Permit). The County MS4 Permit became effective December 28, 2012 Order No. R4-2012-175 is the fourth iteration of the stormwater permit for MS4s in the County, which includes the Los Angeles County Flood Control District, the County, and 84 incorporated cities (including the City of Los Angeles) within the County watersheds, excluding the City of Long Beach. This permit requires runoff issues to be addressed during major phases of urban development (planning, construction, and operation) to reduce the discharge of pollutants from stormwater to the maximum extent practicable, effectively prohibit non-stormwater discharges, and protect the beneficial uses of receiving waters. The MS4 permit requires implementation of a Stormwater Quality Management Plan.

The County MS4 Permit includes total maximum daily load provisions designed to ensure that the County achieves waste load allocations and meets other requirements of total maximum daily loads covering receiving waters affected by the County's MS4 discharges. The County MS4 Permit also contains provisions that allow the permit to be modified, revoked, reissued, or terminated under certain circumstances. For example, provisions may be incorporated as a result of future amendments to the Basin Plan, such as a new or revised water quality objective or the adoption or reconsideration of a total maximum daily load, including program implementation.

The County MS4 Permit allows permittees the flexibility to develop Watershed Management Programs or Enhanced Watershed Programs to implement the requirements of the permit on a watershed scale through customized strategies, control measures, and BMPs. An Enhanced Watershed Program provides guidance for municipalities throughout the County to simultaneously comply with federal and State water quality mandates; improve the quality of rivers, creeks and beaches; and address current and future regional water supply challenges. Enhanced Watershed Programs identify current and future multi-benefit projects that will capture, treat, and use or infiltrate as much stormwater as possible.

Los Angeles County Building Code

> Title 26: The purpose of the code is to provide minimum standards to preserve the public health, safety, and general welfare by regulating the design, construction, installation, quality of materials, use, occupancy, location, and maintenance of all buildings, structures, grading, and certain equipment. The code applies to the construction, alteration, moving, demolition, repair, use of any building or structure, and grading within the unincorporated territory of the County of Los Angeles or use by the County of Los Angeles in any incorporated city.

Los Angeles County General Plan, Safety Element (Los Angeles County 2015)

Goal S 1. An effective regulatory system that prevents or minimizes personal injury, loss of life and property damage due to seismic and geotechnical hazards.

- **Policy S 1.1.** Discourage development in Seismic Hazard and Alquist-Priolo Earthquake Fault Zones.
- **Policy S 1.2.** Prohibit the construction of most structures for human occupancy adjacent to active faults until a comprehensive fault study that addresses the potential for fault rupture has been completed.
- **Policy S 1.3.** Require developments to mitigate geotechnical hazards, such as instability and landsliding, in Hillside Management Areas through siting and development standards.

Los Angeles County General Plan, Conservation and Natural Resources (Los Angeles County 2015)

Goal C/NR 14. Protected historic, cultural, and paleontological resources

- **Policy C/NR 14.1.** Mitigate all impacts from new development on or adjacent to historic, cultural, and paleontological resources to the greatest extent feasible.
- **Policy C/NR 14.2.** Support an inter-jurisdictional collaborative system that protects and enhances historic, cultural, and paleontological resources.
- **Policy C/NR 14.5.** Promote public awareness of historic, cultural, and paleontological resources.
- **Policy C/NR 14.6.** Ensure proper notification and recovery processes are carried out for development on or near historic, cultural, and paleontological resources.

Local

Frame 1

City of Long Beach

City of Long Beach General Plan, Seismic Safety Element (City of Long Beach 1988)

Development Goal 1. Utilize seismic safety considerations as a means of encouraging and enhancing desired land use patterns.

Development Goal 2. Provide an urban environment which is safe as possible from seismic risks.

Development Goal 3. Use physical planning as a means of achieving greater degrees of protection from seismic safety standards.

Development Goal 4. Encourage development that would be most in harmony with nature and thus less vulnerable to earthquake damage.

Development Goal 5. Strive to encourage urbanization patterns which preserve and/or create greater earthquake safety for residents and visitors.

Protection Goal 1. Reduce public exposure to seismic risks.

Remedial Action Goal 1. Eliminate or reconstruct uses and structures which pose seismic risks.

The City of Long Beach does not have specific general plan or historic preservation plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Los Angeles

City of Los Angeles General Plan, Safety Element (City of Los Angeles 1996)

Hazard Mitigation

Goal 1. A city where potential injury, loss of life, property damage and disruption of the social and economic life of the city due to fire, water related hazard, seismic event, geologic conditions or release of hazardous materials disasters is minimized.

- **Policy 1.1.6.** State and federal regulations. Assure compliance with applicable state and federal planning and development regulations (e.g., Alquist-Priolo Earthquake Fault Zoning Act, State Mapping Act, and Cobey-Alquist Flood Plain Management Act).

City of Los Angeles General Plan, Conservation and Open Space Element

Goal 1. Protect cultural heritage resources including historical, archaeological, paleontological and geological sites; encourage public use of cultural heritage sites consistent with the protection of these resources; promote public awareness of cultural resources; and encourage private owners to protect cultural heritage resources.

- **Section 3.** The City's paleontological resources are protected for historical, cultural research and/or educational purposes. Mandates the identification and protection of significant paleontological sites and/or resources known to exist or that are identified during "land development, demolition, or property modification activities."

Frame 2

Unincorporated County Areas

Applicable regulations are described above.

City of Carson

Carson General Plan, Safety Element (City of Carson 2004)

Goal: SAF-1: Minimize the risk of injury, loss of life, and property damage caused by earthquake hazards.

- **Policy: SAF-1.1** Continue to require all new development to comply with the most recent City Building Code seismic design standards.
    - **Implementation Measure SAF-IM-1.1** Apply City Building Code consistently to all development.

The City of Carson does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Compton

Draft Compton General Plan 2030, Public Safety Element (City of Compton 2011)

- **Public Safety Policy 1.1.** The City of Compton will maintain high standards for the seismic performance of new buildings.
- **Public Safety Policy 1.4.** In the Alquist-Priolo Zone, the City of Compton will require geologic review in the development approval process to determine surface rupture potential, and regulate development as appropriate.

- **Public Safety Policy 1.5.** In areas with liquefaction potential, the City of Compton will require the review of soils and geologic conditions, and if needed, on-site borings, to determine liquefaction susceptibility of the proposed site.

Draft Compton General Plan 2030, Open Space and Recreation Element

- **5.3.5 Resource Management Programs.** Cultural Resource Management. Should archaeological or paleontological resources be encountered during excavation and grading activities, all work would cease until appropriate salvage measures are established. Appendix K of the California Environmental Quality Act (CEQA) Guidelines shall be followed for excavation monitoring and salvage work that may be necessary. Preservation efforts will be undertaken pursuant to Appendix K requirements outlined in CEQA.

Frame 3

Unincorporated County Areas

Applicable regulations are described above.

City of Compton

Applicable regulations are described above.

City of Cudahy

Cudahy 2040 General Plan, Safety Element (City of Cudahy 2018)

- **Policy SE 4.1.** Ensure and maintain the structural and operational integrity of essential public facilities during earthquakes and flooding.
- **Policy SE 4.2.** Identify structural types, land uses, materials storage practices, and sites that are highly sensitive to seismic induced ground shaking, liquefaction, and other geological hazards. Seek to abate or modify them to achieve acceptable levels of risk.
- **Policy SE 5.1.** Implement mitigation measures included in Cudahy's 2015 Hazard Mitigation Plan and subsequent updates.

The City of Cudahy does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Downey

Downey Vision 2025 General Plan, Safety Chapter (City of Downey 2005)

Goal 5.5. Address the potential hazards associated with seismic activities.

- **Policy 5.5.1.** Minimize damage in the event of a major earthquake.
    - **Program 5.5.1.4.** Ensure the preparation of geotechnical reports for developments to address soil liquefaction hazards.

The City of Downey does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Lynwood

City of Lynwood General Plan Public Health and Safety (City of Lynwood 2003)

GEO-1. Protect the public health, safety and welfare and minimize the damage to structures, property, and infrastructure as a result of seismic activity.

- **Policy GEO-1.4.** Seismic Safety by Design. Ensure that all new construction is designed to meet current safety regulations.

The City of Lynwood does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Paramount

Paramount General Plan, Health and Safety Element (City of Paramount 2007) Paramount

Health and Safety Element

- **Health and Safety Element Policy 7.** The City of Paramount will work to minimize serious injury and loss of life in the event of a major disaster
- **Health and Safety Element Policy 12**. The City of Paramount will require special soils and structural investigations for all larger structures or development involving large groups of people pursuant to State requirements.

Resource Management Program

- **Cultural Resource Management.** Should archaeological or paleontological resources be encountered during excavation and grading activities, all work would cease until appropriate salvage measures are established. Appendix K CEQA Guidelines will be followed for excavation monitoring and salvage work that may be necessary. Salvage and preservation efforts will be undertaken pursuant to Appendix K requirements outlined in CEQA.

City of South Gate

South Gate General Plan 2035, Healthy Community Element (City of South Gate 2009)

Objective HC 8.1: Regulate new development to prevent the creation of new geologic and seismic hazards.

- **Policy P.1.** New underground utilities, particularly water and natural gas lines, will be designed to meet the most current seismic resistant design standards.
- **Policy P.2.** Soil and/or geologic reports will continue to be required, as appropriate, for development in potentially seismic areas.
- **Policy P.3.** The City will consider information about geologic hazards whenever making decisions influencing land use, building density, building configurations or infrastructure.
- **Policy P.5.** All new construction will conform to the Uniform Building Code, which specifies requirements for seismic design, foundations and drainage.

The City of South Gate does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

Frame 4

Unincorporated County Areas

Applicable regulations are described above.

City of Bell

City of Bell 2030 General Plan (City of Bell 2018)

Resource Management Programs

- **Cultural Resource Management.** Should archaeological or paleontological resources be encountered during excavation and grading activities, all work would cease until appropriate salvage measures are established. Appendix K of the California Environmental Quality Act (CEQA) Guidelines shall be followed for excavation monitoring and salvage work that may be necessary. Salvage and preservation efforts will be undertaken pursuant to Appendix K requirements outlined in CEQA.

City of Bell Gardens

City of Bell Gardens General Plan 2010 (City of Bell Gardens 1995)

Safety Element

- **Policy 2.** The City of Bell Gardens shall minimize the loss of life, injuries, and property damage through continuing prevention, inspection, and public education programs, including continual update of the City's Emergency Preparedness Plan.

The City of Bell Gardens does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Commerce

City of Commerce 2020 General Plan (City of Commerce 2008)

Safety Element

- **Safety Policy 4.1.** The City of Commerce will ensure that appropriate mitigation measures relative to soil contamination and soils characteristics (subsidence, erosion, etc.) are required for development and redevelopment in order to reduce hazards.
- **Safety Policy 4.3.** The City of Commerce will work with the Los Angeles County Department of Building and Safety to identify and monitor those buildings that represent a risk in the event of a major earthquake.

Resource Management Program

- Cultural Resource Management. Should archaeological or paleontological resources be encountered during excavation and grading activities, all work would cease until appropriate salvage measures are established. Appendix K CEQA Guidelines will be followed for excavation monitoring and salvage work that may be necessary. Salvage and preservation efforts will be undertaken pursuant to Appendix K requirements outlined in CEQA.

City of Huntington Park

City of Huntington Park 2030 General Plan (City of Huntington Park 2017)

Health and Safety Element

- **Health and Safety Element Policy 2.** In areas with liquefaction potential, the City of Huntington Park shall require review of soils and geologic conditions, and if necessary, on-site borings, to determine liquefaction susceptibility of the proposed site.

The City of Huntington Park does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Maywood

City of Maywood General Plan (City of Maywood 2015)

Safety Element

Goal 1. Protect the lives, health, and property of the residents of the City of Maywood from flooding, fire and geologic hazards.

- **Policy 1.1** Continue to implement and enforce stringent site and safety criteria for new construction in the City, and require existing structures be brought up to standards.
- **Policy 1.4** Establish and enforce standards and criteria to reduce unacceptable levels of risk from flooding, fire and geologic hazards.

The City of Maywood does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

City of Vernon

City of Vernon General Plan (City of Vernon 2015)

Safety Element

Goal S-1. Minimize the risk to public health, safety, and welfare associated with the presence of natural and human-caused hazards.

Goal S-4. Provide a high degree of protection for all workers and residents in the event of any disaster.

- **Policy S-4.2.** Review the design of new development projects to consider public safety and issues such as emergency access, defensible space, and overall safety.

The City of Vernon does not have specific general plan elements, goals, policies, or ordinances regarding paleontological resources.

Frame 5

City of Los Angeles

Applicable regulations are described above.

Frame 6

City of Los Angeles

Applicable regulations are described above.

City of Glendale

City of Glendale General Plan

Safety Element (City of Glendale 2003)

- **Policy 1-1.** The City shall ensure that new buildings are designed to address earthquake hazards and shall promote the improvement of existing structures to enhance their safety in the event of an earthquake.
  - **Program 1-1.1.** The City shall adopt and enforce the latest version of Title 24 of the California Code of Regulations (California Building Code) with local amendments, including near-source seismic conditions.
- **Policy 1-2.** The City shall enforce the provisions of the Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act, with additional local provisions.
  - **Program 1-2.1.** The City shall require geological studies as part of development proposals in the Fault Hazard Management Zones. The studies shall be conducted by State-certified engineering geologists following the guidelines published by the California Geological Survey (Note 49). The City shall require a State certified engineering geologist or registered civil engineer, having competence in the field of seismic hazard evaluation and mitigation, to review the study at the applicant's expense. The review shall determine the adequacy of the hazard evaluation and proposed mitigation measures and determine whether the requirements of State law are satisfied, as described in Note 49: Guidelines for Evaluating the Hazard of Surface Fault Rupture by the California Geological Survey.
- **Policy 1-4.** The City shall ensure that current seismic and geologic knowledge and State-certified professional review are incorporated into the design, planning and construction stages of a project, and that site-specific data are applied to each project.
  - **Program 1-4.1.** The City shall develop and make available to the public a list of State-certified engineering geologists and registered civil engineers, having competence in the field of seismic hazard evaluation and mitigation, to review, at the applicant's expense, all geologic and geotechnical reports, including fault studies, for proposed development or redevelopment, and to review grading operations.
- **Policy 2-1**. The City shall avoid development in areas of known slope instability or high landslide risk when possible, and will encourage that developments on sloping ground use design and construction techniques appropriate for those areas.
  - **Program 2-1.1.** The City shall require geological and geotechnical investigations in areas of potential seismic or geologic hazards as part of the environmental and development review process. The City will not issue permits for development or redevelopment until assured that all potential geologic hazards have been mitigated.
  - **Program 2-1.2.** The City shall require preliminary geological investigations of tract sites by State-registered geotechnical engineers and certified engineering geologists (in accordance with the California Building Code and the City of Glendale's Grading, Fills and Excavations Code – City Code 15.12).

- **Program 2-1.3.** In those areas of Glendale susceptible to slope instability, the City shall require geotechnical investigations that include engineering analyses of slope stability, provide surface and subsurface drainage specifications, and provide detailed design for fill placement and excavation.
- **Program 2-1.4.** The City shall discourage any grading beyond that which is necessary to create adequate and safe building areas. The City shall conduct regular inspection of grading operations to maximize site safety and compatibility with community character.
- **Program 2-1.5.** The City shall prohibit grading that is inconsistent with the Grading Ordinance. The City shall encourage the use of varied slope ratios on manufactured slopes to reduce the visual impact of grading.

Open Space and Conservation Element (City of Glendale 1993)

- **Policy 3**: Cultural, historical, archaeological and paleontological structures and sites are essential to community life and identity and should be recognized and maintained.

Frame 7

Unincorporated County Areas

Applicable regulations are described above.

City of Los Angeles

Applicable regulations are described above.

City of Burbank

Burbank2035 General Plan (City of Burbank 2013)

Safety Element

Goal 5 Seismic Safety. Injuries and loss of life are prevented, critical facilities function, and property loss and damage is minimized during seismic events.

- **Policy 5.1.** Require geotechnical reports for development within a fault area that may be subject to risks associated with surface rupture.
- **Policy 5.2.** Require geotechnical reports for new development projects in areas with the potential for liquefaction or landslide.
- **Policy 5.3.** Enforce seismic design provisions of the current California Building Standards Code related to geologic, seismic, and slope hazards.

Open Space and Conservation Element

Goal 6 Open Space Resources. Burbank's open space areas and mountain ranges are protected spaces supporting important habitat, recreation, and resource conservation.

- **Policy 6.1** Recognize and maintain cultural, historical, archeological, and paleontological structures and sites essential for community life and identity.

Frame 8

City of Los Angeles

Applicable regulations are described above.

Frame 9

City of Los Angeles

Applicable regulations are described above.

3.6.3 Impact Analysis

3.6.3.1 Methods

This analysis qualitatively evaluates the construction and operations impacts of the proposed Project on geologic, soils, and paleontological resources based on desktop review of geologic and soils conditions within and adjacent to the project study area. The impacts were assessed on a programmatic level based on the relevant regulatory framework.

Impacts associated with Typical Projects (i.e., the Common Elements and Multi-Use Trails and Access Gateways), the six kit of parts (KOP) categories and related design components, and the *2020 LA River Master Plan* in its entirety are analyzed qualitatively at a program level. Where the two Typical Projects or the six KOP categories have similar impacts related to a specific criterion, the discussion is combined. Where differences between the Typical Projects or the KOP categories are identified, the impact analysis is presented separately. Furthermore, construction and operations impacts are presented together where they largely overlap and it would not be meaningful to discuss them separately to address a specific criterion.

3.6.3.2 Criteria for Determining Significance

Thresholds of Significance

For the purposes of the analysis in this PEIR, and in accordance with Appendix G of the State CEQA Guidelines, the proposed Project would have a significant environmental impact if it would:

3.6(a) Directly or indirectly cause 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

3.6(b) Result in substantial soil erosion or the loss of topsoil.

3.6(c) 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 an onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.

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

3.6(e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal where sewers are not available for the disposal of waste water.

3.6(f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

3.6.3.3 Impacts and Mitigation Measures

Impact 3.6(a): Would the proposed Project directly or indirectly cause 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?**

Typical Projects

Common Elements and Multi-Use Trails and Access Gateways Typical Projects

Construction

Frames discussed together under Impact 3.6(a) have similar characteristics as related to the geologic hazards listed.

Frame 1 and Frame 2

Generally speaking, for typical footprints involved under the Common Elements Typical Project, construction activities are not expected to disturb a significant amount of soil, from the smallest scale disturbing surface soils only to deeper excavations of several feet (in the case of Tier III pavilions). Although the Multi-Use Trails and Access Gateways Typical Project would potentially involve deeper excavations and larger footprints than Common Elements Typical Project, construction activities would still be considered too shallow and small in scale to cause or exacerbate significant geologic phenomena such as fault rupture, seismic ground shaking, or liquefaction.

However, as described above in Section 3.6.2.1, *Geologic Setting*, the LA River is in a seismically active area due to the various active and potentially active faults in the region. Seismic events from one or more of these regional active or potentially active faults could result in strong ground shaking in the LA River area. Consequently, it is possible that the Typical Projects could be affected by strong ground shaking.

In addition to being subject to strong seismic shaking, fault zone and landslide prone areas exist along the LA River. The Newport–Inglewood fault zone traverses areas of Long Beach along Frames 1 and 2 (Figure 3.6-1 and Figure 3.6-2), to the east and southeast of where I-710 and I-405 intersect. Fault zones are described by CGS as regulatory zones surrounding the surface traces of active faults. If the Typical Projects are to be constructed within these zones, they would be subject to fault zone regulations, wherein, prior to a new project being permitted in a fault zone, cities and counties require a geologic investigation to demonstrate that proposed structures will not be constructed on active faults.

In addition, the majority of Frames 1 and 2 are within liquefaction zones (Figure 3.6-1 and Figure 3.6-2). Per CGS, liquefaction zones identify where the stability of foundation soils must be evaluated, resulting in site mitigation (e.g., compaction piles, stone columns, deep soil mixing). If any Typical Projects are to be constructed within a liquefaction zone, they could be subject to liquefaction zone mitigation recommendations.

There are no landslide hazard areas[2] within Frames 1 and 2.

Construction of the Typical Projects would be consistent with prevailing building codes and relevant regulations and permits[3] and would be required to follow fault zone regulations if constructed in fault zones, and implement countermeasures to address liquefaction risks if constructed in liquefaction zones.

Frame 3 and Frame 4

There are no fault zones within Frames 3 and 4. As mentioned, the LA River channel is in a seismically active area; therefore, projects within Frames 3 and 4 could be subject to strong seismic shaking as a result of regional seismic activity. As such, the analysis under Frames 1 and 2 related to strong seismic shaking would also apply to Frames 3 and 4.

All of Frame 3 and the vast majority of Frame 4 are in liquefaction-prone areas (Figure 3.6-1 and Figure 3.6-2). Construction of the Typical Projects in these areas would be subject to seismic hazard zone requirements for liquefaction zones, and construction of Typical Projects would adhere to the prevailing building codes that would help minimize risk from seismic activity.

There are no landslide hazard areas within either Frame 3 or Frame 4.

[2] Designated landslide hazard areas identify where the stability of hillslopes must be evaluated and countermeasures undertaken in the design and construction of buildings (California Department of Conservation 2019).

[3] Permits certify a building project met the current building code requirements and, when necessary, conformed to approved plans and specifications. Permit issuance is generally preceded by a plan check review and is dependent upon the approval of other required agencies that may be triggered based on the type of project. New buildings; new, expanded, or replaced electrical items; and grading work are some activities requiring a building permit.

Frame 5 through Frame 9

The project area within Frame 5 through Frame 9 would also be subject to strong seismic shaking as a result of regional seismic activity. Therefore, the analysis under Frames 1 and 2 related to strong seismic shaking would also apply to Frames 5 through 9.

The northern portion of Frame 5, central portion of Frame 6, eastern portion of Frame 7, and majority of Frames 8 and 9 are within a liquefaction zone (Figure 3.6-1 and Figure 3.6-2). The Typical Projects constructed in these areas would be subject to liquefaction hazard requirements, as detailed previously.

Unlike Frames 1 through 4 described above, portions of Frames 5 through 9 are also in areas designated as landslide hazard areas (these are areas with variation in topography adjacent to the Santa Monica Mountains). According to the Department of Conservation, these zones identify where the stability of hillslopes must be evaluated and countermeasures undertaken in the design and construction.

Although construction of the Typical Projects would adhere to the prevailing building codes and relevant regulations and permits, which would help minimize risk from seismic activity, and would be subject to fault zone, liquefaction, and landslide hazard regulations if constructed in these zones, there is still potential for substantial adverse effects involving strong seismic shaking, fault rupture, liquefaction, and landslides.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing[4] Subsequent Projects Prior to Construction Activities.

Prior to final design of subsequent projects that would feature load-bearing structures (e.g., Tier III pavilions), the implementing agency will ensure that a licensed geologist and engineer will prepare a design-level geotechnical investigation prior to construction.

The investigation will include subsurface soil sampling, laboratory analysis of samples collected to determine soil characteristics and properties (including identifying and defining the limits of unstable, compressible, and collapsible soils), and an evaluation of the laboratory testing. Recommendations based on the results will be used in the design specifications for the proposed subsequent projects. The report will include recommendations to avoid potential risks associated with seismic hazards (including ground shaking and fault rupture, seismically induced landslides, liquefaction, and the other seismic effects described in this section), in accordance with the specifications of CGS's Special Publication 117A, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, and the requirements of the Seismic Hazards Mapping Act. The geotechnical study will provide detailed project-specific recommendations for design and construction, and implementation of those recommendations will be required during

[4] Load-bearing structures are structures that carry and transfer load to the ground safely (i.e., load-bearing walls transfer loads to the foundation or other suitable frame members and can support structural members like beams, slab, and walls on floors above).

construction of relevant projects. Mitigation to address potential fault rupture, seismic ground shaking, ground failure, and liquefaction hazards can include (but are not limited to) the following:

- **Fault rupture:** Studies will evaluate the location and relative activity of potentially active fault splays at the project site and the feasibility of locating future site improvements will be conducted by geologic consultants as part of the geotechnical study. Fault investigations will be conducted by a California State Certified Engineering Geologist and submitted to CGS. Appropriate building setback zones will be established in locations deemed not feasible for construction of occupied structures.
- **Seismic ground shaking:** Structural elements of subsequent projects will be designed to resist or accommodate appropriate site-specific ground motions and conform to current seismic design standards, including those set forth by prevailing building codes.
- **Liquefaction/ground failure:** Assessment of liquefaction potential at subsequent project sites will be conducted as part of the geotechnical study. Structural design will be developed to reduce the potential impacts of liquefaction, including the incorporation of techniques such as structural design, in-situ ground modification, or supporting foundations with piles at depths designed specifically for seismically induced settlement.
- **Landslides:** Where applicable, assessment for landslide potential and/or potential for surficial failure will be performed as part of the geotechnical study with measures to be incorporated into the design, as appropriate. Mitigation measures in areas subject to a landslide hazard could include the following measures: excavation of potentially unstable material for a more stable slope configuration; reduction of landslide-driving forces by removal of earth materials at the top of the landslide; construction of a buttress and/or stabilization fills; construction of retaining walls installation of rock bolts on a slope face, and/or installation of protective wire mesh on a slope face; construction of debris impact walls at the toe of the slope to contain rock fall debris, or other such measures.

The following measures could be recommended in the site-specific geotechnical study to mitigate the potential effects of unstable and/or expansive soils:

- **Groundwater:** Excavations for improvements in areas with shallow perched groundwater may need to be cased, shored, and/or dewatered to maintain stability of the excavations and adjacent improvements and provide access for construction.
- **Collapsible soils/settlement:** Assessment of soil settlement will be performed as part of the geotechnical study and techniques will be recommended, as appropriate, to reduce impacts related to settlement. Assessment of settlement potential of onsite natural soils and undocumented fill will include drilling of exploratory borings or test pits and laboratory testing of soils. Possible mitigation measures for soils with the potential for settlement could include removal of the compressible/collapsible soil layers and replacement with compacted fill, surcharging to induce settlement prior to construction of improvements, allowing for a settlement period after or during construction of new fills, and utilization of specialized foundation design, including the use of deep foundation systems, to support structures. Various in-situ soil improvement techniques are also available, such as dynamic compaction (i.e., heavy tamping) or compaction grouting.
- **Expansive soils:** Assessment of the potential for expansive soils will be performed as part of the geotechnical study, and mitigation techniques, such as over-excavation and

replacement with non-expansive soils, soil treatment, moisture management, and/or specific structural design for expansive soil conditions, will be developed, as appropriate.

The implementing agency will apply the recommendations of the site-specific geotechnical study to minimize risks related to potential fault rupture, seismic ground shaking, ground failure, and liquefaction hazards/landslides.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

All Frames

As operations activities associated with the Typical Projects would not differ from frame to frame, the following operational discussion applies to all frames. Implementation of the Typical Projects would attract visitors to the study area (the Common Elements Typical Project would attract up to 500 visitors and the Multi-Use Trails and Access Gateways Typical Project would attract up to 1,000 visitors); as such, visitors could be exposed to strong seismic shaking, fault rupture, and secondary seismic phenomena such as liquefaction and landslides. However, as mentioned under *Construction* above, any development occurring in fault, liquefaction, and landslide zones would require evaluation and countermeasures implemented in design and construction. All Typical Projects would be implemented following proper engineering methods and building code requirements. Operations activities associated with the Typical Projects, which mainly include recreational uses and wayfinding, would not cause or exacerbate major geological phenomena such as strong seismic shaking, fault rupture, or any secondary phenomena such as liquefaction or landslides; furthermore, visitors would only be on site on a temporary basis, as the Typical Projects do not include permanent human occupancy in the design. Nonetheless, there could be potential impacts on people or structures from risks associated with seismic phenomena (including fault rupture, seismic ground shaking, ground failure, and liquefaction hazards/landslides).

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

2020 LA River Master Plan Kit of Parts

The Common Elements Typical Project analyzed above could be implemented in whole or as a combination of its individual elements with all the KOP categories discussed below. Therefore, for potential impacts of the Common Elements Typical Project, see above; the impact discussion below focuses on specific KOP categories only.

Certain design components of KOP Category 1 inform the Multi-Use Trails and Access Gateways Typical Project analyzed above in more detail. Therefore, for potential construction and operation impacts of these design components, see above. The design components analyzed in this section include those listed in Section 2.5.1 under the *KOP Category 1: Trails and Access Gateways* heading.

KOP Categories 1 through 6

Construction

Construction activities for KOP Categories 1 through 6 would be similar, as would construction equipment. KOP Categories 1 through 6 include a variety of construction activities ranging from trail improvement to access gateways, channel modifications, crossings and platforms, diversions, floodplain reclamation, housing, and off-channel land assets anywhere in the study area; therefore, the potential for exposure to seismic hazards exists. As mentioned previously, the potential for seismic hazards exists throughout the footprint, in the case of strong seismic shaking, and in areas that exhibit specific conditions conducive of other seismic hazards (such as fault, liquefactions, and landslide zones). Although the specific location, configuration, and design for KOP Categories 1 through 6 are unknown, all projects constructed as part of the *2020 LA River Master Plan* would adhere to prevailing building codes, and KOP Categories 1 through 6 constructed within geologic hazard zones would require evaluation.

Similar to Typical Projects, construction activities associated with KOP Categories 1 through 6 would be small in scale and too shallow to cause or exacerbate significant geologic phenomena.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

> **Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.**

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

KOP Categories 1 through 6 design components have not been determined; however, these projects are likely to attract additional visitors to areas within the *2020 LA River Master Plan*. As such, visitors could be exposed to strong seismic shaking, fault rupture, and secondary seismic phenomena, such as liquefaction and landslides. Development occurring in fault zones or liquefaction or landslide hazard areas would require evaluation and mitigation measures to be implemented (as necessary). In addition, these projects would be developed according to the prevailing building codes, thereby minimizing the potential geologic hazard risk to visitors.

As KOP categories would be implemented following proper engineering methods and building code requirements, operations activities associated with KOP Categories 1 through 6 are not expected to cause or exacerbate major geological phenomena, such as strong seismic shaking, fault rupture, or any secondary phenomena, such as liquefaction or landslides. Furthermore, visitors would only be on site on a temporary basis for KOP Categories 1 through 5, as those KOP categories do not include permanent human occupancy in their design. Permanent occupancy is a feature included in KOP Category 6; however, as already stated, the projects would adhere to all applicable regulations and requirements, including pre-construction investigations, as applicable. Impacts would be less than significant on visitors as well as permanent residents.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Overall 2020 LA River Master Plan Implementation

Construction and Operation

The *2020 LA River Master Plan* includes up to 107 potential projects, ranging in size from extra-small (less than 1 acre) to extra-large (150+ acres/10+ miles), that would be implemented over the 25-year horizon period to meet the *2020 LA River Master Plan*'s nine objectives. These would include the Typical Projects that would be constructed at a specified cadence, or spacing, along the river to ensure equitable distribution of facilities throughout the 51-mile-long corridor and help improve access and safety, as well as additional subsequent projects from the KOP categories' multi-benefit design components. The construction of these projects, including specific location (e.g., planning frame, in-channel/off-channel), design, and timing, would depend on many factors that are currently unknown at this time.

As mentioned individually under the *Typical Projects* and *2020 LA River Master Plan Kit of Parts* sections above, all projects to be identified and implemented under the *2020 LA River Master Plan* would require evaluation if constructed in geologic hazard areas. All *2020 LA River Master Plan* projects would adhere to all building code and permitting requirements and, if necessary, geotechnical investigations. This would reduce potential impacts associated with geologic hazards to less-than-significant levels for short-term (construction) and long-term (i.e., operations) activities associated with the implementation of the *2020 LA River Master Plan*.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Impact 3.6(b): Would the proposed Project result in substantial soil erosion or the loss of topsoil?

Typical Projects

Common Elements and Multi-Use Trails and Access Gateways Typical Projects

Construction

Frames 1 through 9 are discussed together, as the erosion analysis would apply to all Typical Projects in all frames.

Erosion is a condition that could adversely affect development on any site; therefore, this analysis applies to construction of both the Common Elements and Multi-Use Trails and Access Gateways Typical Projects in any frame. Construction activities could exacerbate erosion conditions by exposing soils and adding water to the soil from irrigation and runoff from new impervious surfaces. The Typical Projects could disturb up to 3 acres under the Common Elements Typical Project and a 5-mile-long and 40-foot-wide area under the Multi-Use Trails and Access Gateways Typical Project. As described in Section 3.9, *Hydrology and Water Quality,* of this PEIR, any project involving grading of an area greater than 1 acre (or less than 1 acre, but part of a larger common plan of development) would be required to obtain NPDES coverage under the NPDES Construction General Permit, Order No. 2009-0009-DWQ (State Water Resources Control Board 2020). Construction activities covered under the Construction General Permit include clearing, grading, and disturbances to the ground, such as stockpiling or excavation. The Construction General Permit would require the development and implementation of a SWPPP, which includes BMPs to regulate stormwater runoff, including measures to prevent soil erosion (typical construction BMPs can include silt fences, straw waddles, sediment traps, gravel sandbag barriers, etc.) and loss of topsoil. Erosion management would be implemented during and after construction, as exposed slopes would be treated to avoid dust and sediment erosion. Additional details regarding erosion management are provided in Section 3.9, *Hydrology and Water Quality*. For Typical Projects involving less than 1 acre of soil disturbance, a SWPPP would not be required; however, construction BMPs would still be implemented to minimize erosion and the discharge of pollutants off site. Compliance with permit requirements, along with implementation of BMPs, would minimize the erosion potential during construction; as such, impacts would be less than significant.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Operations

Operations activities associated with the Common Elements or Multi-Use Trails and Access Gateways Typical Projects would not include any activities that would cause or exacerbate conditions leading to substantial erosion or loss of topsoil. Stormwater BMPs[5] as part of the Common Elements Typical Project would treat all surface runoff associated with storm events and filtering sediments, further reducing the likelihood of significant amounts of sediments leaving the project site. Foot and animal traffic involved in trail use under the Multi-Use Trails and Access Gateways Typical Project could disturb trail materials and increase potential for erosion; however, the Multi-Use Trails and Access Gateways Typical Project could be paved with concrete, asphalt, stone fines, and decomposed granite, compacted earth, or permeable paving (as part of the Access and Mobility Design Guidelines), as applicable, and could help minimize erosional conditions. As described in Section 3.9, *Hydrology and Water Quality*, of this PEIR, soil erosion during operation of a Typical Project would be minimized through site drainage design and maintenance practices. In addition, Typical Project operations would comply with the County MS4 Permit and its associated provisions, applicable low-impact development requirements from local jurisdictions, and local stormwater management programs, as required.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

2020 LA River Master Plan Kit of Parts

The Common Elements Typical Project analyzed above could be implemented in whole or as a combination of its individual elements with all the KOP categories discussed below. Therefore, for

[5] BMPs help capture, convey, and infiltrate stormwater during a rain event and may include rain gardens, swales, infiltration strips, and infiltration trenches.

potential impacts of the Common Elements Typical Project, see above. The impact discussion below focuses on specific KOP categories only.

Certain design components of KOP Category 1 inform the Multi-Use Trails and Access Gateways Typical Project analyzed above in more detail. Therefore, for potential construction and operation impacts of these design components, see above. The design components analyzed in this section include those listed in Section 2.5.1 under the *KOP Category 1: Trails and Access Gateways* heading.

KOP Categories 1 through 6

Construction

Construction activities for KOP Categories 1 through 6 would be similar, as would construction equipment. KOP Categories 1 through 6 include a variety of construction activities ranging from trail improvement to access gateways, channel modifications, crossings and platforms, diversions, floodplain reclamation, and off-channel land assets, anywhere in the study area. Construction activities associated with these projects could exacerbate erosion conditions by exposing soils and adding water to the soil from irrigation and runoff from new impervious surfaces. Similar to the Multi-Use Trails and Access Gateways Typical Project, KOP categories would involve larger footprints and, therefore, would be required to obtain NPDES coverage under the Construction General Permit. A SWPPP as part of the Construction General Permit would require BMPs to regulate stormwater runoff and prevent soil erosion. Erosion management would be implemented during and after construction.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Operations

Operations activities associated with KOP Categories 1 through 6 are not expected to include any activities that would cause or exacerbate conditions leading to substantial erosion or loss of topsoil. Foot and animal traffic involved in trail use could disturb trail materials; however, KOP Categories 1 through 6 would be paved with concrete, asphalt, stone fines, and decomposed granite, compacted earth, or permeable paving, thereby minimizing erosional conditions.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Overall 2020 LA River Master Plan Implementation

Construction and Operation

As mentioned individually under the *Typical Projects* and *2020 LA River Master Plan Kit of Parts* sections above, all large projects to be included under the *2020 LA River Master Plan* would require obtaining coverage under the Construction General Permit, minimizing the amount of erosion during construction. For smaller Typical Projects, construction BMPs would still be implemented to minimize erosion and the discharge of pollutants off site. In addition, erosion management would be implemented during construction and after construction is complete. This would reduce potential impacts associated with erosion to less-than-significant levels for short-term (construction) and long-term (operations) activities associated with the implementation of the *2020 LA River Master Plan*.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Impact 3.6(c): Would the proposed Project be located on a geologic unit or soil that is unstable or that would become unstable as a result of the Project and potentially result in an onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse?

Typical Projects

Common Elements and Multi-Use Trails and Access Gateways Typical Projects

Construction and Operations

Due to the nature of the projects, operational impacts associated with Typical Projects would not include activities that would contribute significantly to soil instability and are therefore discussed along with construction impacts. Frames 1 through 9 are discussed together under Impact 3.6(c) because they contain similar conditions as related to the geologic hazards listed.

For a discussion of landslide and liquefaction hazards during construction and operations, see Impact 3.6(a) above.

As the LA River footprint covers 51 linear miles, soil components along and adjacent to the river vary substantially in secondary components; however, the largest portion and primary component of soils within the project study area are classified as Urban Land by the Natural Resources

Conservation Service. Urban Land typically consists of soils in areas of high population density in the largely built environment (which is the most common description of the land surrounding the LA River). These soils can be significantly changed human-transported materials, human-altered materials, or minimally altered or intact "native" soils. Soils in urban areas can exhibit a wide variety of conditions and properties, making soil instability associated with lateral spreading, liquefaction, or collapse possible (U.S. Department of Agriculture 2019). The Common Elements and Multi-Use Trails and Access Gateways Typical Projects constructed within geologic hazard zones would be subject to geologic hazard zone requirements, and the Typical Projects would be required to follow the prevailing building codes and, if necessary, prepare a geotechnical investigation. In addition, the *Los Angeles County General Plan* Safety Element includes goals and policies for addressing the introduction or expansion of developments in areas known to have geologic hazards, thereby further minimizing potential impacts. Nonetheless, due to the lack of site-specific details, there remains a potential for presence of potentially unstable soils in the project study area.

Operations activities associated with the Typical Projects primarily include recreation, social and cultural opportunities from cafés, arts/performance spaces, and trails, and would not include any activities that would cause or exacerbate soil instability including landslide, lateral spreading, subsidence, liquefaction, or collapse.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

2020 LA River Master Plan Kit of Parts

The Common Elements Typical Project analyzed above could be implemented in whole or as a combination of its individual elements with all the KOP categories discussed below. Therefore, for potential impacts of the Common Elements Typical Project, see above. The impact discussion below focuses on specific KOP categories only.

Certain design components of KOP Category 1 inform the Multi-Use Trails and Access Gateways Typical Project analyzed above in more detail. Therefore, for potential construction and operation impacts of these design components, see above. The design components analyzed in this section include those listed in Section 2.5.1 under the *KOP Category 1: Trails and Access Gateways* heading.

KOP Categories 1 through 6

Construction

KOP Categories 1 through 6 include a variety of construction activities ranging from trail improvement to access gateways, channel modifications, crossings and platforms, diversions, floodplain reclamation, and off-channel land assets. As mentioned previously, the potential for seismic hazards exist throughout the footprint, including areas that exhibit specific conditions potentially subject to seismic hazards such as liquefaction and seismically induced landsliding. In addition, the majority of soil components surrounding the LA River are classified as Urban Land by the Natural Resources Conservation Service. These soils can be significantly changed human-transported materials, human-altered materials, or minimally altered or intact "native" soils. Soils in urban areas can exhibit a wide variety of conditions and properties, increasing the potential for soil instability.

All projects constructed as part of the *2020 LA River Master Plan* would adhere to applicable building codes, and KOP Categories 1 through 6 constructed within geologic hazard areas would require evaluation. Construction activities associated with KOP categories are considered too shallow and small in scale to cause or exacerbate geologic hazards.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

> **Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.**

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

KOP Categories 1 through 6 design components are likely to attract additional visitors to areas within the *2020 LA River Master Plan*. As such, visitors could be exposed to the effects of soil instability. KOP Categories 1 through 6 design components, once complete, could also be exposed to secondary seismic phenomena, such as liquefaction, landsliding, or subsurface conditions potentially subject to instability. Development occurring in liquefaction and seismically induced landslide areas would require evaluation and countermeasures to be implemented (as necessary). In addition, these projects would be developed with prevailing building codes, thereby minimizing the potential seismic risk to visitors.

As KOP categories would be implemented following proper engineering methods and building code requirements, operation activities associated with KOP Categories 1 through 6 are not expected to cause or exacerbate major geological hazards such as strong seismic shaking, fault rupture, or secondary seismic effects due to liquefaction or landsliding. All projects would adhere to applicable regulations and requirements, including pre-construction investigations. Impacts would be less than significant.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Overall 2020 LA River Master Plan Implementation

Construction and Operation

As mentioned individually under *Typical Projects* and *2020 LA River Master Plan Kit of Parts* sections above, all projects to be included under the *2020 LA River Master Plan* would require evaluation if constructed in State-designated geologic hazard areas and fault zones. Additionally, all *2020 LA River Master Plan* projects would adhere to all building code and permitting requirements, including geotechnical evaluations where appropriate. This would mitigate potential impacts associated with geologic hazards to less-than-significant levels for short-term (construction) and long-term (operations) activities associated with the *2020 LA River Master Plan* implementation.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Impact 3.6(d): Would the proposed Project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

Typical Projects

Common Elements and Multi-Use Trails and Access Gateways Typical Projects

Construction and Operation

Due to the nature of the projects, operational impacts associated with Typical Projects would not include activities that would contribute significantly to soil instability and are therefore discussed along with construction impacts. Frames 1 through 9 are discussed together under Impact 3.6(d) because they contain similar conditions as related to expansive soils.

Soil components along and adjacent to the LA River are composed primarily of soils classified as Urban Land and can exhibit a wide variety of conditions and properties, including expansive potential. Urban soils could contain fine-grained soils (silts and clays), which contain variable amounts of expansive minerals—that is, soils that expand when they get wet and shrink as they dry out. Upward pressure can increase when these expansive soils swell, which may result in detrimental effects on structures and surface improvements if not property mitigated. The Common Elements and Multi-Use Trails and Access Gateways Typical Projects would be required to comply with all applicable building codes and permit requirements, thereby minimizing the potential for substantial direct or indirect expansive soil impacts on structures and visitors. In addition, the Typical Projects' operations activities primarily include social, cultural, and recreation opportunities from cafés, arts/performance spaces, and trails, none of which would be expected to cause or exacerbate the expansive potential in onsite soils. Furthermore, visitors would only be on site on a temporary basis, as none of the Typical Projects include permanent human occupancy elements. However, due to the presence of expansive soils in the project study area, impacts could be significant.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

2020 LA River Master Plan Kit of Parts

The Common Elements Typical Project analyzed above could be implemented in whole or as a combination of its individual elements with all the KOP categories discussed below. See above for potential impacts of the Common Elements Typical Project. The impact discussion below focuses on specific KOP categories only.

Certain design components of KOP Category 1 inform the Multi-Use Trails and Access Gateways Typical Project analyzed above in more detail. See above for potential construction and operation impacts of these design components. The design components analyzed in this section include those listed in Section 2.5.1 under the *KOP Category 1: Trails and Access Gateways* heading.

KOP Categories 1 through 6

Construction

KOP Categories 1 through 6 include a variety of construction activities for design components ranging from trail improvement to access gateways, channel modifications, crossings and platforms, diversions, floodplain reclamation, and off-channel land assets, which can be anywhere in the study area. Soil components surrounding the LA River are primarily classified as Urban Land by the Natural Resources Conservation Service. As previously stated, soils in urban areas can exhibit a wide variety of conditions and properties, including expansive soils.

KOP Categories 1 through 6 constructed as part of the *2020 LA River Master Plan* would adhere to all current building codes and required permitting requirements. As projects would be implemented following proper engineering methods and building code requirements, it is expected that none of the activities associated with the construction of KOP Categories 1 through 6 would cause or exacerbate expansive characteristics in soils. However, due to the presence of expansive soils in the study area, impacts could be significant.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

> **Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.**

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

KOP Categories 1 through 6 design components are likely to attract additional visitors and residents to areas within the *2020 LA River Master Plan*. As such, people could be exposed to the potential effects of soil expansion on project structures. However, projects would be built and adhere to all applicable building codes, thereby minimizing the potential risk to visitors.

As mentioned under construction, projects would be implemented following proper engineering methods and building code requirements. Additionally, activities associated with KOP Categories 1 through 6 operations are not expected to include activities that would cause or exacerbate expansive characteristics in soils.

Impact Determination

Impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

Impacts would be less than significant. No mitigation is required.

Overall 2020 LA River Master Plan Implementation

Construction and Operation

As mentioned individually under the Typical Projects and KOP categories above, all projects to be included under the *2020 LA River Master Plan* would adhere to all building code and permitting requirements, along with implementing recommendations from site-specific geotechnical studies, when deemed necessary. This would reduce potential impacts associated with expansive soils to less-than-significant levels for short-term (construction) and long-term (operations) activities associated with *2020 LA River Master Plan* implementation.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-1: Conduct a Site-Specific Geotechnical Study and Implement Recommendations for Load-Bearing Subsequent Projects Prior to Construction Activities.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Impact 3.6(e): Would the proposed Project have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal where sewers are not available for the disposal of waste water?

There are no septic tanks or alternative wastewater disposal systems being proposed as part of the Typical Projects, six KOP categories, or the overall *2020 LA River Master Plan* implementation. No impacts would occur.

Impact Determination

No impacts would occur.

Mitigation Measures

No mitigation is required.

Significance after Required Mitigation

No impacts would occur. No mitigation is required.

Impact 3.6(f): Would the proposed Project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Typical Projects

Common Elements and Multi-Use Trails and Access Gateways Typical Projects

Construction

Construction of the Common Elements and Multi-Use Trails and Access Gateways Typical Projects would generally involve site disturbance, movement of construction equipment, and import and export of materials. Construction would occur along the right-of-way and include an area of approximately 3 acres (for the Common Elements Typical Project) or up to 40 acres (for the Multi-Use Trails and Access Gateways Typical Project) and last about 10 months or 20 months, respectively. Ground disturbance would include site clearing and excavation. Excavation would be a maximum depth of 7 feet bgs to construct pavilions and install footings for bollards, lighting, or fences and generally 2 feet bgs for trails. Thirty-two previously recorded and as-yet-unrecorded paleontological localities have been identified in seven of the nine frames of the study area. All nine frames contain deposits considered sensitive for containing significant unrecorded paleontological vertebrate fossils. Construction of the Typical Projects could destroy, remove, disturb, and alter surface-exposed and buried paleontological resources, resulting in an adverse change in the significance of the resource.

Sensitive paleontological deposits exist at various depths below the current ground surface within all nine frames of the study area. For this PEIR analysis, all sensitive deposits identified across the study area, regardless of documentation depth, resulted in sensitive results and a potentially significant impact determination. Specific project areas and components have not been formalized, so the PEIR analyzes impacts in a general approach for all nine frames and provides a list of project-specific assessment needs that would be conducted as project-specific locations are identified.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Mitigation Measure GEO-2: Conduct Paleontological Resources Investigations.

During design of individual subsequent projects and prior to construction, the implementing agency will conduct paleontological resource investigations consistent with SVP Guidelines. This process will include:

- Conducting a paleontological records search through the Los Angeles County Natural History Museum to identify previously recorded paleontological localities and the presence of sensitive deposits in the proposed project study area
- Reviewing project design and maximum depths and extents of project ground disturbance components
- Reviewing publicly available geotechnical reports for information concerning subsurface deposits and deposit depths across the project area
- Identifying the potential for sensitive paleontological deposits underlying the proposed Project that project implementation could affect
- Determining whether impacts on sensitive deposits, if present, would be significant

If no sensitive deposits are identified or if they are sufficiently deeper than the proposed project excavations and would not be encountered during construction, no further steps will be required.

If sensitive deposits are identified and could be affected by the proposed Project, implement Mitigation Measure GEO-3.

Mitigation Measure GEO-3: Avoid Paleontological Resources or Conduct Monitoring.

The implementing agency will redesign the subsequent project to avoid sensitive paleontological resources and deposits that could potentially contain these resources. If avoidance and/or project redesign is not feasible, then paleontological monitoring will be implemented and will include the following implementation steps:

- The implementing agency will retain a qualified paleontologist, who will attend the preconstruction meeting(s) to consult with the grading and excavation contractors or subcontractors concerning excavation schedules, paleontological field techniques, and safety issues. A *qualified paleontologist* is defined as an individual (1) who has an MS or PhD in paleontology or geology; (2) who also has demonstrated familiarity with paleontological procedures and techniques; (3) who is knowledgeable in the geology and paleontology of the County; and (4) who has worked as a paleontological mitigation project supervisor in the County for at least 1 year.
- A paleontological monitor or a qualified paleontologist will be on site on a full-time basis during excavation and ground-disturbing activities that occur in any undisturbed deposits below ground surface, to inspect exposures for contained fossils. The paleontological monitor will work under the direction of the proposed Project's qualified paleontologist. A *paleontological monitor* is defined as an individual selected by the qualified paleontologist who has experience in the collection and salvage of fossil materials.

- If fossils are discovered on a development site, the qualified paleontologist will recover them and temporarily direct, divert, or halt grading to allow recovery of fossil remains.
- The qualified paleontologist will be responsible for the cleaning, repairing, sorting, and cataloguing of fossil remains collected during the monitoring and salvage portion of the mitigation program.
- Prepared fossils, along with copies of all pertinent field notes, photos, and maps, will be deposited (as a donation) at a scientific institution with permanent paleontological collections, such as the Los Angeles County Natural History Museum. Donation of the fossils will be accompanied by financial support for initial specimen storage, paid for by the project proponent.
- Within 30 days after the completion of excavation and ground-disturbing activities, the qualified paleontologist will prepare and submit to the implementing agency a paleontological resource recovery report that documents the results of the mitigation program. This report will include discussions of the methods used, stratigraphic section(s) exposed, fossils collected, and significance of recovered fossils.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

Operation activities related to the Common Elements and Multi-Use Trails and Access Gateways Typical Projects could include new single-story structures, such as pavilions, cafés, or restrooms, or lower-profile infrastructure, such as multi-use trails, signs, lighting, benches, and other associated recreational facilities, which may introduce activities that could directly affect significant paleontological resources. Operation elements, such as potentially increased erosion, even though not substantial, along proposed trail alignments, facilities, and recreational areas could result from increased public use. Additionally, introducing recreationists and trail users to new facilities associated with the Typical Projects near an area with exposed deposits that are sensitive for significant paleontological resources could directly affect any undiscovered resources, through exposure and removal from unanticipated disturbance and increased public use.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Mitigation Measure GEO-4: Avoid/Minimize Impacts on Paleontological Resources During Operations.

If significant paleontological resources and sensitive deposits with the potential to contain significant paleontological resources are identified within a project area during design/planning of individual projects (Mitigation Measures GEO-2 and GEO-3), and deposits that are sensitive for significant paleontological resources remain exposed at or near the ground surface or become exposed during project operations, then an avoidance and minimization plan will be prepared to avoid/minimize potential impacts during operations. This plan may include, but not be limited to:

- Securing sensitive deposits from accessibility through the development of Environmentally Sensitive Areas
- Preparing an operations and maintenance plan to minimize degradation and exposure of sensitive deposits
- Designing and developing interpretive exhibits to provide education and understanding of the importance of avoiding and protecting sensitive deposits and paleontological resources

If significant impacts on a newly exposed or existing significant paleontological resource cannot be avoided, then Mitigation Measure GEO-3 will need to be implemented.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

2020 LA River Master Plan Kit of Parts

KOP Categories 1 through 6

Construction

Similar to the Typical Projects, construction of the KOP categories would generally involve site disturbance, movement of construction equipment, construction staging areas, and import and export of materials, all of which could result in an adverse effect on significant paleontological resources. Impacts may be direct, through proposed ground disturbance, which could destroy, remove, disturb, or alter surface-exposed and buried paleontological resources.

Sensitive paleontological deposits exist at various depths below the current ground surface within all nine frames of the study area. For this PEIR analysis, all sensitive deposits identified across the study area, regardless of documentation depth, resulted in sensitive results and a potentially significant impact determination. Specific project areas and components have not been formalized so the PEIR analyzes impacts with a combined approach to include all frames and provides a list of project-specific assessment needs that will need to be conducted as project-specific locations are identified.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measures, which are described above.

Mitigation Measure GEO-2: Conduct Paleontological Resources Investigations.

Mitigation Measure GEO-3: Avoid Paleontological Resources or Conduct Monitoring.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

Potential impacts from operation of the design components under the KOP categories would vary depending on the specific component and its intended function, as well as on the specific location, including in-channel or off-channel. The specific location, configuration, and design for these components have not been determined yet and would depend on numerous factors, including project proponent and availability of funding. As described in Chapter 2, *Project Description*, and under the construction section above, the KOP categories include a variety of construction scenarios that include ground-disturbing activities. The operation of the KOP categories could result in significant impacts on sensitive geologic deposits with the potential for containing undiscovered significant paleontological resources, which include increased erosion along proposed trail alignments, facilities, and recreational areas from increased public use and increased potential for disturbance. These activities could result in the exposure, disturbance, and potential destruction through damage or removal of previously unrecorded significant paleontological resources. Other KOP operations that include the construction of off-channel water features and floodplain storage and wetlands could expose previously undocumented surface-exposed or buried significant paleontological resources through stream, off-channel, and floodplain water aggradation/erosional processes.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-4:. Avoid/Minimize Impacts on Paleontological Resources During Operations.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Overall 2020 LA River Master Plan Implementation

Construction

The construction impacts of the 107 projects in the *2020 LA River Master Plan* would be similar to those of the KOP categories. Some projects would cover more area than others, but the same general construction equipment and activities would be involved, e.g., the use of backhoes, trucks, hand-held power equipment, and generators. As noted, the projects are expected to be constructed over a 25-year period. Therefore, it is possible that construction activities could result in an adverse change to a significant paleontological resource, resulting in a significant impact.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measures, which are described above.

Mitigation Measure GEO-2: Conduct Paleontological Resources Investigations.

Mitigation Measure GEO-3: Avoid Paleontological Resources or Conduct Monitoring.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Operations

The operations impacts of the 107 projects in the *2020 LA River Master Plan* would be similar to those of the KOP categories, which could result in significant impacts on sensitive geologic deposits with the potential for containing undiscovered significant paleontological resources, including increased erosion along proposed trail alignments, facilities, and recreational areas from increased public use and increased potential for removal and disturbance. These activities could result in the exposure, disturbance, and potential destruction through damage or removal of previously unrecorded significant paleontological resources. Other KOP operations that include off-channel water features and floodplain storage and wetlands could expose surface-exposed or buried significant paleontological resources through stream or off-channel degradation processes and water erosional processes related to floodplain storage activities.

Impact Determination

Impacts would be potentially significant.

Mitigation Measures

Apply the following mitigation measure, which is described above.

Mitigation Measure GEO-4: Avoid/Minimize Impacts on Paleontological Resources During Operations.

Significance after Required Mitigation

Impacts would be less than significant for later activities when carried out by the County.

Impacts would be significant and unavoidable for later activities when not carried out by the County.

Cumulative Impacts

The geographic context for an analysis of cumulative impacts on geology, soils, and paleontological resources is the greater Los Angeles region, as it is composed of similar soil types, is a seismically active region, and was heavily settled by Native Americans, and the area contains abundant paleontological resources. A description of the regulatory setting and approach to cumulative impacts analysis is provided in Section 3.0.2.

Criteria for Determining Significance of Cumulative Impacts

The proposed Project would have the potential to result in a cumulatively considerable impact on geology and soils, if, in combination with other projects within the greater Los Angeles region, it would directly or indirectly cause 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, or 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 an onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse; be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property; have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal where sewers are not available for the disposal of waste water , or directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Cumulative Condition

As discussed in the *Los Angeles County General Plan Update Draft Environmental Impact Report* (2014), most of Southern California, including the cumulative programs and projects in the greater Los Angeles region, is in an area of relatively high seismic activity, and buildout and development of the cumulative programs and projects in the County would expose additional people and new infrastructure to the effects of earthquakes, seismically related ground failure, liquefaction, and seismically induced landslides.

Future cumulative development in the surrounding area would be subject to local, State, and federal regulations pertaining to geology and soils, including the CBC and, in the County area, Los Angeles County Building Code requirements. These regulations contain requirements for development in areas that are subject to Seismic Design Categories E and F. In addition, cumulative projects would be subject to the Alquist-Priolo Earthquake Fault Zone Act, which restricts development on active fault traces. Adherence to these regulations and standard engineering conditions would help reduce cumulative impacts related to geology and soils (Los Angeles County 2014). Implementation of transportation projects and land use strategies included in the 2020 Regional Transportation Plan/Sustainable Communities Strategy within the Southern California Association of Governments (SCAG) region would contribute to cumulative significant impacts with regard to the potential to expose additional people and infrastructure to the effects of earthquakes, seismic related ground failure, liquefaction, and seismically induced landslides due to thousands of acres of land subject to severe peak ground acceleration, potential liquefaction, and potential earthquake-induced landslides within 500 feet of major SCAG projects; tens of thousands of acres subject to moderate or high soil erosion within 500 feet of major SCAG projects; and several miles being within the Alquist-

Priolo EFZ (SCAG 2020). In addition, expansive soils and paleontological resources are present throughout the SCAG region, and larger transportation projects and regional land use strategies in particular may result in significant cumulative impacts where projects are within areas of expansive soils and such resources. Even with implementation of mitigation measures, these cumulative impacts would remain significant (SCAG 2020). Therefore, there is a cumulative condition with respect to geology, soils, and paleontological resources.

Contribution of the Project to Cumulative Impacts

The *2020 LA River Master Plan* project area could be subject to strong seismic ground shaking or unstable soil conditions. Construction activities would not be expected to be at depths sufficient to cause significant geologic events (e.g., fault rupture, landslides, seismic ground shaking, liquefaction) or exacerbate geologic conditions because Mitigation Measure GEO-1 would be implemented. Geologic conditions in the area would remain unchanged as a result of the proposed Project. However, landslide- and liquefaction-prone areas as well as areas with collapsible soils could expose workers to geologic hazards. The proposed Project would comply with all applicable regulations and would be consistent with goals and policies contained in the applicable general plans.

Construction activities could exacerbate erosion conditions by exposing soil or adding water to the soil, either from irrigation or runoff from new impervious surfaces. BMPs, such as silt fences, straw waddles, sediment traps, gravel sandbag barriers, or other effective BMPs, would be implemented to control runoff and erosion during construction activities. Implementation of erosion and sediment control BMPs would prevent substantial soil erosion and sedimentation. Construction activities associated with the proposed Project would not create a geologic hazard by causing or accelerating instability related to erosion, and adherence to Construction General Permit requirements would reduce potential impacts during construction to less-than-significant levels. Therefore, impacts related to geology and soils would not be cumulatively considerable.

The *2020 LA River Master Plan* could occur in or near undiscovered fossil resources (e.g., within Quaternary alluvium deposits, at depths of up to 3 feet; younger alluvium, at depths greater than 5 feet; and areas of older alluvium or paleontologically sensitive surface bedrock). The proposed Project would require notification and inventory of paleontological resources and implementation of an unanticipated discovery plan to mitigate potentially significant impacts (Mitigation Measures GEO-2, GEO-3, and GEO-4). Therefore, the *2020 LA River Master Plan* would not make a cumulatively considerable contribution to impacts on paleontological resources.