## 3.2.3 Geology/Soils/Seismic/Topography

This section of the environmental document references findings from the *District Preliminary Geotechnical Report* (December 2011).

### 3.2.3.1 Regulatory Setting

For geologic and topographic features, the key federal law is the Historic Sites Act of 1935, which establishes a national registry of natural landmarks and protects "outstanding examples of major geological features." Topographic and geologic features are also protected under CEQA.

This section also discusses geology, soils, and seismic concerns as they relate to public safety and project design. Earthquakes are prime considerations in the design and retrofit of structures. Caltrans Office of Earthquake Engineering is responsible for assessing the seismic hazard for Department projects. Structures are designed using Caltrans Seismic Design Criteria (SDC). The SDC provides the minimum seismic requirements for highway bridges designed in California. A bridge's category and classification will determine its seismic performance level and which methods are used for estimating the seismic demands and structural capabilities. For more information, please see Caltrans Division of Engineering Services, Office of Earthquake Engineering, SDC.

### 3.2.3.2 Affected Environment

The project is generally in the Orange County portion of the Central Block within the Los Angeles Basin. This portion of Orange County is part of the Peninsular Range Geomorphic Province of California. The basin is infilled with up to 4,200 ft of relatively unconsolidated Pleistocene marine and nonmarine sediments overlain by up to 170 ft of unconsolidated nonmarine Quaternary and Holocene alluvial sediments. The depth of the unconsolidated sediments is generally shallowest near the south end of the project, becoming deeper towards the north.

The project is located within an alluvial plain that is composed of a mixture of soils including sand, clay, and gravel. The project area includes multiple alluvial soils associated with the Santa Ana River and San Gabriel River systems, including:

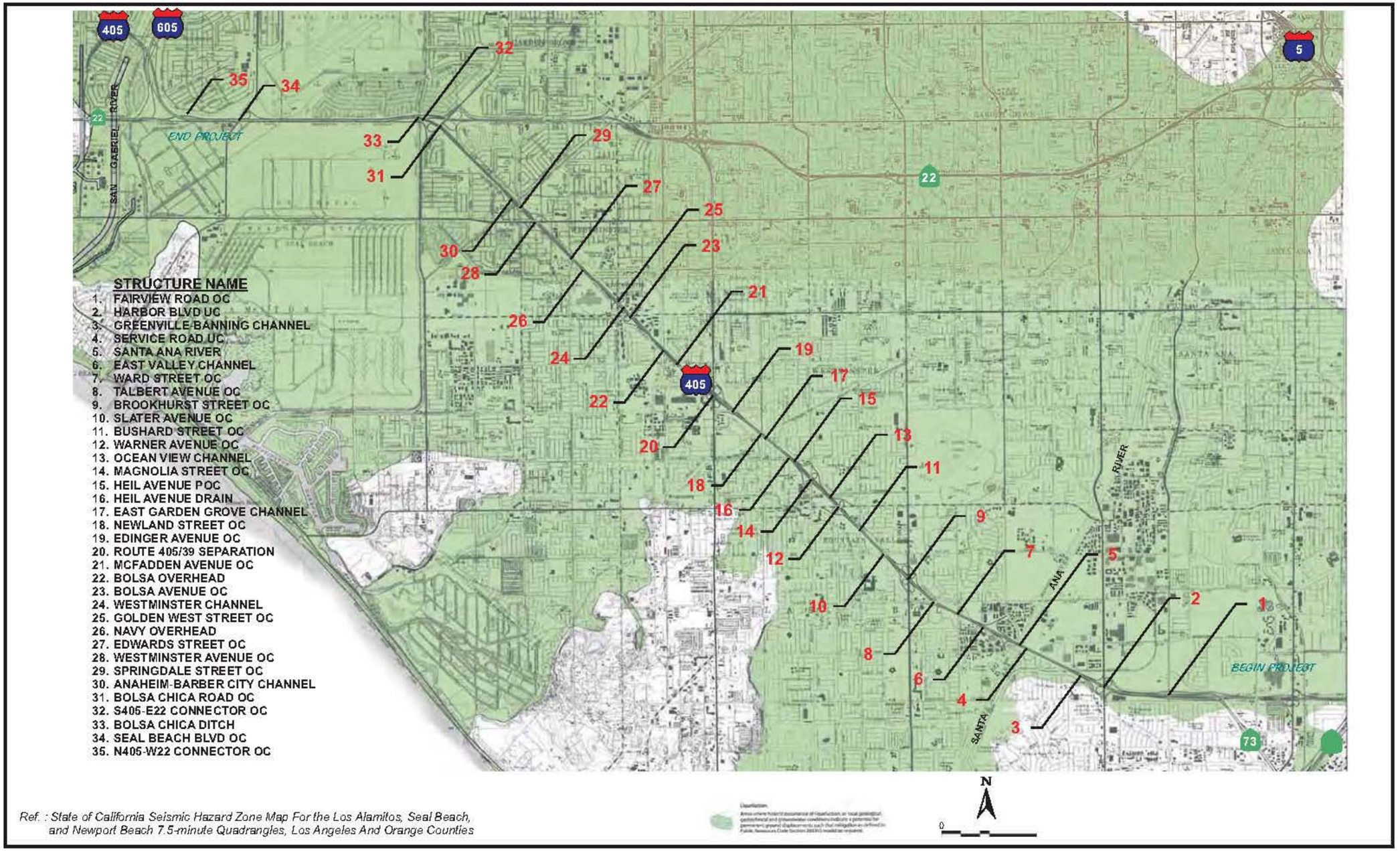
- Alluvium (Qya)
- Alluvial fan deposits (Qyf)

Due to construction of suburban housing and transportation corridors throughout the project area, manmade fills have been placed over the alluvial soils. Underneath these manmade fills, the project area is located in an alluvial plain with soils exhibiting potential for liquefaction during a seismic event. The State of California's Seismic Hazard Zone maps identify the area to be located within a liquefaction hazard zone (see green area in Figure 3.2.3-1). The project area also has an historical groundwater level to a depth of 5 to 20 ft below the natural site grades.

The project is located within seismically active southern California. The regional tectonics of the area includes many subparallel northwest-southeast trending right lateral strike slip faults (i.e., Newport-Inglewood, Palos Verdes, and Whittier-Elsinore Fault Zones), which are part of the larger San Andreas Fault system, and a series of reverse and blind thrust faults (e.g., San Joaquin Hills Blind Thrust, Compton-Los Alamitos Blind Thrust, THUMS Huntington Beach, and Puente Hills Blind Thrust Faults). Major active faults in the project area, based on Caltrans 2007 Fault Database, are shown on the Caltrans ARS Online Fault Maps in Figures 3.2.3-2 and 3.2.3-3. The following three major faults are located within approximately less than 5 miles from the project area:

- The San Joaquin Hills Blind Thrust Fault (Maximum Magnitude 6.6, Reverse), which dips to the southwest below the southern portion of the project, with minimum depth of 1.25 miles; the surface projection of the shallowest portion of the fault is located at a closest distance of approximately 0.4-mile to the northeast;
- The Newport-Inglewood-Rose Canyon Fault Zone (Maximum Magnitude 7.5, Strike Slip), which is located at a variable distance of approximately 1.25 to 3 miles southwest of the alignment; and
- The Compton-Los Alamitos Blind Thrust Fault (Maximum Magnitude 6.8, Reverse), which dips to the northeast below the entire project alignment, with a minimum depth of 3 miles; the surface projection of the shallowest portion of the fault is located at a variable horizontal distance of 4 to 6 miles to the southwest of the site.

Due to the flat topography within the area of the project, soils are not susceptible to landslide. Furthermore, there are no views of natural landforms or landmarks subject to obstruction due to the proposed project that would be subject to protection (see Section 3.1.7, Visual/Aesthetics, for more information).




*Ref. : State of California Seismic Hazard Zone Map For the Los Alamitos, Seal Beach, and Newport Beach 7.5-minute Quadrangles, Los Angeles And Orange Counties*

**Figure 3.2.3-1: Seismic Hazard Zone Map**

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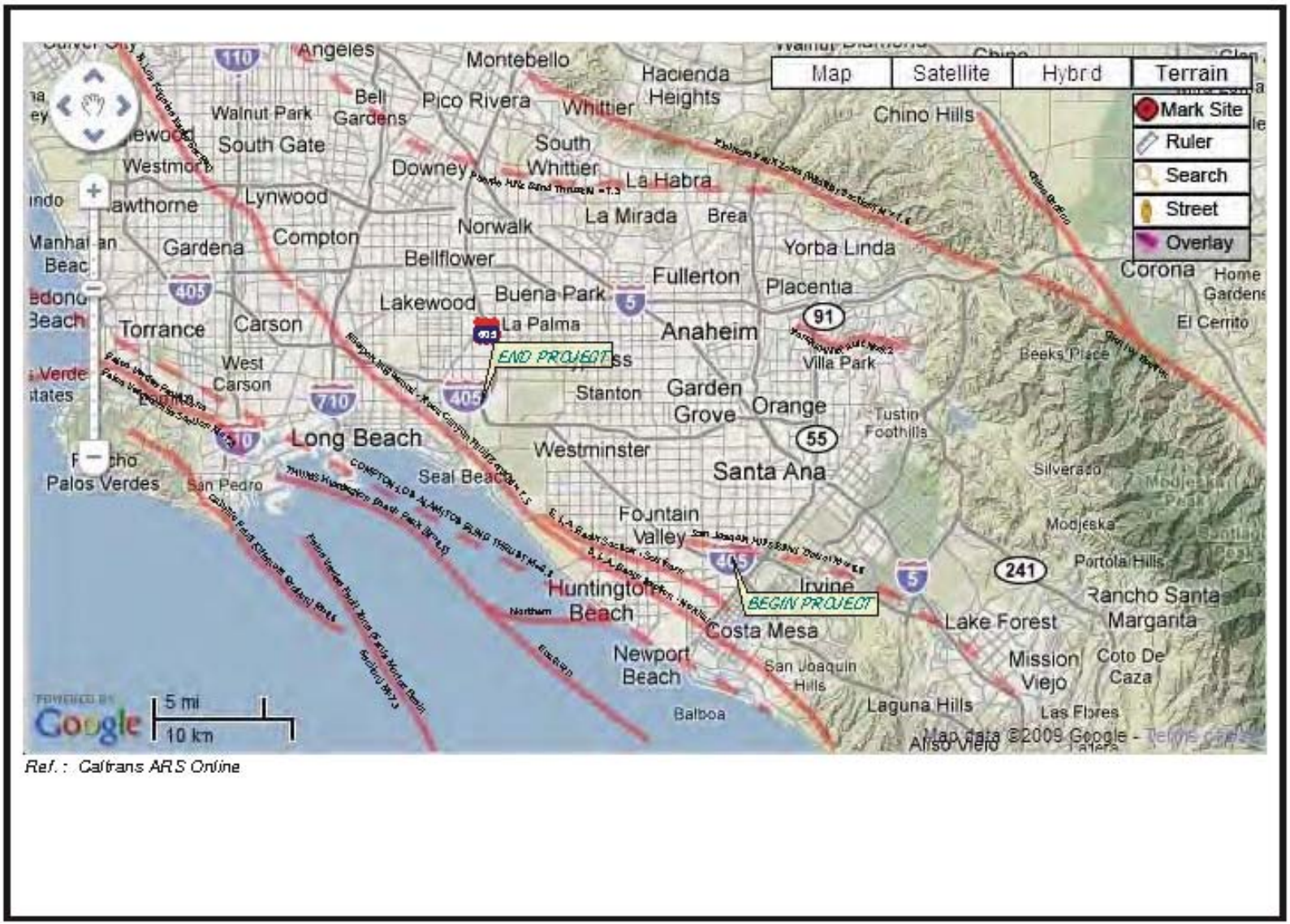


*Ref.: Caltrans ARS Online*

**Figure 3.2.3-2: Major Active Faults in the Project Area**

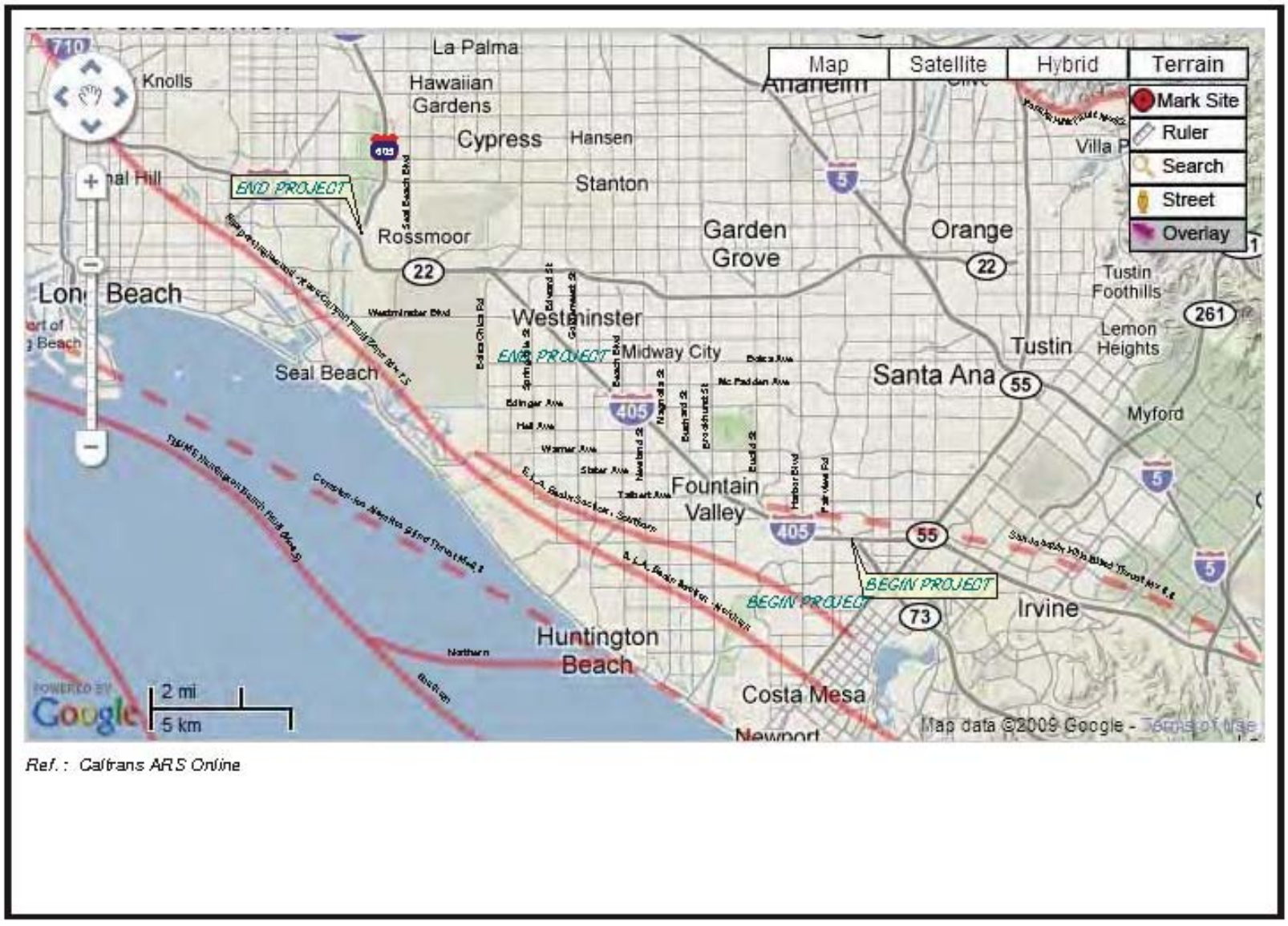


**Figure 3.2.3-3: Major Active Faults in the Project Area**

### 3.2.3.3 Environmental Consequences

#### *Permanent Impacts*

##### No Build Alternative

Under the No Build Alternative, there would be no change to the freeway configuration and no improvements to interchanges; therefore, there would be no permanent impacts as a result.

##### Build Alternatives

The project location is not within an Alquist-Priolo Special Studies or Earthquake Fault Zone. Consequently, the potential for ground rupture in the project area because of fault movement is low; however, several major faults are located within 50 miles of the project area. A major earthquake associated with any of these faults could result in moderate to severe ground shaking in the project area.

The project is located in an area with a potential for high liquefaction during a seismic event; therefore, the project would be designed to meet current design standards for both Caltrans and the cities adjacent to the project corridor to minimize liquefaction hazards. The current risks associated with liquefaction at the interchange area would remain the same as existing conditions if any of the proposed build alternatives were constructed; therefore, the proposed build alternatives would not have the potential to introduce new liquefaction-related hazards.

Although the proposed project site is located in seismically active southern California, it is within an existing transportation corridor. The project would be designed to meet current corridor cities' and Caltrans' design standards to minimize geologic and seismic hazards. No structures would be constructed that would increase the current risk of loss, injury, or death as a result of ground shaking or other seismically induced effects. The proposed project would not increase the risk of exposing people or structures to potential substantial adverse effects because of seismic activities or seismic-related ground failure beyond the existing level already present with the current freeway configuration.

Measures GEO-1 through GEO-7, as well as BMPs related to erosion control identified in Section 3.2.2, Water Quality and Stormwater Runoff, have been incorporated to ensure that the project is designed to minimize any potential long-term operational hazards due to ground motion, liquefaction, and load-bearing concerns related to seismic activities.

### *Temporary Impacts*

#### No Build Alternative

There would be no change to the existing conditions under the No Build Alternative; therefore, there would be no temporary impacts as a result.

#### Build Alternatives

The site is in a State of California mapped Liquefaction Hazard Zone and has relatively shallow groundwater, layers of loose to medium dense saturated granular soils, and moderate to high earthquake accelerations; therefore, liquefaction potential should be considered high. Quantitative liquefaction assessment, potential impacts, and mitigation measures for each embankment, retaining wall, sign foundation, and other roadway structure should be addressed in the PS&E-level geotechnical investigation. Depending on the groundwater levels and the actual density, depth, layer thickness, fines content, plasticity, and post-liquefaction strength of potentially liquefiable soils, these impacts may include ground settlement, reduced foundation bearing capacity, and/or seismic slope instability. The peak ground accelerations and a magnitude of 7 would be appropriate for preliminary liquefaction analysis. If results of site-specific investigation indicate high potential for seismic slope instability or lateral spreading, then additional mitigation, such as soil improvement/ground modifications, could be required.

There are no natural slopes in the project area, and the site is not in a mapped landslide hazard zone. Potential for seismic-induced slope failures in the project area would be limited to lateral spreading of fill embankments due to ground shaking, combined with the presence of soft soils and/or loss of soil shear strength due to liquefaction.

Groundwater levels are generally within 10 ft of the lowest site elevations. In general, soils close to the groundwater are soft materials. Excavations extending close to elevation +20 ft in most areas of the alignment are likely to encounter soft soils and the permanent groundwater table. Deeper open excavations will require dewatering.

In the SR-22 WCC Project near the SR-22 interchange, soils were determined to be corrosive due to high chlorides and sulfates. Corrosive conditions are likely to be present in the remainder of the alignment. Existing alluvial soils and fills in the project area may be excavated with moderate effort using conventional heavy-duty grading equipment. No soils or rock requiring blasting or heavy ripping are known to exist in the project area.

Soil loss due to grading and other construction activities is expected to be minimal, and standard Caltrans BMPs would be followed to minimize soil loss and erosion during construction (see Section 3.2.2, Water Quality and Stormwater Runoff, for more information).

### 3.2.3.4 Avoidance, Minimization, and/or Mitigation Measures

**GEO-1:** In accordance with standard Caltrans requirements, detailed geotechnical studies shall be conducted during the project's future PS&E phase. If results of these studies find high potential for seismic slope instability or lateral spreading, additional measures will need to be incorporated for new structures associated with the project, including bridges, embankments, and retaining walls. Resulting recommendations from the detailed studies shall be incorporated into the project's final design plans to address seismic safety, liquefaction, and load-bearing concerns present in the project area.

**GEO-2:** Selection of earth-retaining system types should be based on consideration of foundation bearing capacity, anticipated settlement and ability of the system to tolerate settlements, overall slope stability, constructability, and cost.

**GEO-3:** Depending on locations, drilled piles (for sign foundations or soundwalls) may extend below the groundwater and will require appropriate construction methods.

**GEO-4:** Corrosion mitigation for steel and concrete structures should generally follow Caltrans Corrosion Guidelines (2003 or latest). The latest Caltrans Highway Design Manual (Section 855) provides corrosion requirements for roadway structures (e.g., culverts, signs) for a 50-year design life (Caltrans, 2010).

**GEO-5** The project engineer shall request a Materials Report in the early stage of PS&E. The report shall include the results of field tests and sampling for corrosion (i.e., pH, sulfate, chloride, and minimum resistivity) for use in recommending culvert materials and concrete mix designs. Sampling and testing shall be performed in accordance with Caltrans Corrosion Guidelines (2003 or latest).

**GEO-6** In general, earthwork should be performed in accordance with Sections 6 and 19 of the Caltrans Standard Specifications. The new construction will have to be carefully planned to protect the many existing utilities in the area.

**GEO-7:** Monitoring during construction shall be done by a licensed geologist and engineer to ensure that the construction site was properly characterized by the geotechnical studies and that the project design is in compliance with geotechnical and seismic safety standards and practices included in the final design package.

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