3.5 GEOLOGY AND SOILS

This section examines the regional and local geologic and soil characteristics of the project site and surrounding area. The analysis is based upon the *Geotechnical Investigation, Los Angeles State Historic Park, Los Angeles, California*, prepared by Group Delta Consultants, Inc. in March 2011. This report is included as Appendix E of this EIR.

3.5.1 ENVIRONMENTAL SETTING

The project site is approximately 3,800 feet long, 500 feet wide across the center, and is generally bound by the Metro Gold Line right-of-way on the north, the channelized Los Angeles River on the east, Spring Street on the south, and commercial uses on the west. The project site is relatively level, with grades sloping gradually from approximately 312 feet above mean sea level on the northeastern end to approximately 290 feet above mean sea level on the southwestern end. Currently, the majority of the project site is covered with grass, while other landscaping and decomposed granite pathways are located at the perimeter and portions of the site interior.

GEOLOGIC SETTING

The project site is located in the Los Angeles Basin, which is within the northwestern portion of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges are characterized by northwest trending ranges separated by northwest trending valleys that are subparallel to faults branching from the San Andreas Fault.[1] This geomorphic province extends into lower California and is bound on the east by the Colorado Desert.

Geologically, the project site is located within young Holocene Alluvial Fan Deposits associated with the Los Angeles River and is overlain locally by shallow man-made fills. These fan deposits are primarily composed of sand and gravel. The Los Angeles River alluvial fan is surrounded on the east and west by the Pleistocene Old Alluvial Fan and Old Alluvial Terrace Deposits, as well as outcrops of Tertiary sedimentary rock of the Puente and Fernando Formations. The Elysian Hills northwest of the project site are composed of sandstone and siltstone associated with the Puente Formation.

Soil Conditions

In February 2011, Group Delta Consultants, Inc. conducted a geotechnical investigation of the project site including 9 soil borings and 11 cone penetration tests. Cone penetration testing is used to determine the geotechnical engineering properties of soils and for delineating soil stratigraphy, or rock layers. The soil profile at the project site consists of two layers: 1) shallow near surface fills and more weathered alluvial soils, and 2) dense sandy alluvial fan deposits of the Los Angeles River. Bedrock was not encountered to a depth of 50 feet below ground surface (bgs) of the project site.

---

[1] California Department of Conservation, California Geological Survey, *Note 36*, 2002, available at: http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_36/Documents/note_36.pdf, accessed: April 20, 2011.

The approximately five-foot deep upper soil horizon (Layer 1) at the project site is less consolidated and locally contains clayey topsoil and shallow undocumented fills. Clayey topsoil was encountered in some borings up to two feet bgs. The Layer 1 soils consist of interbedded stiff to hard, lean clays and silts, and medium dense to dense sands, silty sands, and clayey sands. Localized zones of cobbles were observed, particularly near the location of the historic roundhouse on the project site. Below Layer 1, the alluvial soils within Layer 2 generally consist of dense to very dense mixtures of sand, gravel, and silt, with occasional lenses of hard silts and hard, lean clays with sand.

GROUNDWATER

According to the Seismic Hazard Zone Report for the Los Angeles 7.5-minute quadrangle, the historic high groundwater level at the project site is approximately 20 feet bgs. However, more recent data collected during the geotechnical investigation in February 2011indicated groundwater depths of 33.5 to 34 feet bgs. Well data collected from monitoring wells at the project site generally show the highest permanent groundwater levels for the 6-year monitoring period (2000 to 2006) ranging from 25 to 35 feet bgs, with a flow gradient following the natural topography towards the southwest. Groundwater levels within the project area may fluctuate with water levels in the adjacent Los Angeles River, but would not be expected to rise above a depth of 20 feet bgs. Locally, shallower perched groundwater could be present due to seepage from upslope or man-made sources such as leaking utilities.

SEISMIC HAZARDS

The three principal seismic hazards common to properties in southern California are surface rupturing of earth materials along fault traces, damage to structures and foundations due to strong seismic ground shaking (e.g., as generated during an earthquake), and liquefaction.

Surface Fault Rupture

The project site and all of southern California is considered to be a seismically active region. The region has numerous active, potentially active, and inactive faults. An active fault is defined as a fault that has had a surface displacement within Holocene times (approximately the last 11,000 years). A potentially active fault is one that has demonstrated surface displacement of Quaternary age deposits (within the last 1.6 million years). Inactive faults have not moved in the last 1.6 million years.

The project site is located in relatively close proximity to approximately six active earthquake faults including the Upper Elysian Blind Thrust, Puente Hills Blind Thrust, Hollywood Fault, Raymond Fault, Newport-Inglewood Fault Zone, and Whittier-Elsinore Fault Zone. These area faults have a Moment Magnitude of at least 6.5. The Moment Magnitude indicates the size of an earthquake in terms of the energy released. The Upper Elysian Park and Puente Hills Blind Thrust Faults are located directly below the project site, but the depth to rupture surface is at least 1.86 miles, making the potential for fault rupture remote. The Raymond Fault located nearby at approximately 3.5 miles north of the project site.[2]

[2] USGS, Earthquake Hazards Program, *Quaternary Faults in Google Earth*, February 25, 2011. Earthquake fault files from USGS were downloaded and viewed in Google Earth.

The project site is not located within an Alquist-Priolo Fault Zone, and no active or potentially active faults capable of fault rupture are known to traverse the project site. [3]

Ground Shaking

The project site is located in a seismically active area. Ground shaking due to nearby and distant earthquakes should be anticipated during the life of the proposed project.

Liquefaction

Liquefaction involves the sudden loss in strength of saturated, cohesionless soil caused by the build-up of pore water pressure during cyclic loading, such as produced by an earthquake. Liquefaction can cause vertical and lateral ground displacements, slope instability, lateral spreading, and bearing failure. For liquefaction to occur, all of the following must be present:

- Liquefaction-susceptible soils (loose to medium density cohesionless soils);
- Groundwater within 50 feet of the surface; and
- Strong shaking, such as caused by an earthquake.

Due to its location in an area of Holocene alluvium and relatively shallow groundwater, the project site has been identified in State Seismic Hazard Zones for liquefaction.[4] Additionally, the project site is located within an area identified by the City as being susceptible to liquefaction.[5]

Seismically-Induced Settlement

Seismic shaking can also cause soil compaction and ground settlement without liquefaction occurring, including settlement of dry clean sands above the water table. Due to the density of granular soils at the project site, the hazard of seismic compaction is negligible.

Expansion

Expansive soils are clay-based soils that tend to expand (increase in volume) as they absorb water and shrink (lessen in volume) as water is drawn away. Expansive soils can result in damage to structures, slabs, pavements, and retaining walls if wetting and drying of the soil does not occur uniformly across the entire area. Potential for expansion of soils is indicated by the Expansion Index (EI). Table 3.5-1 qualitatively defines expansion potential in terms of the EI value.

---

3 City of Los Angeles Department of City Planning, Environmental and Public Facilities Maps, *Alquist-Priolo Special Study Zones & Fault Rupture Study Areas* Map, September 1996.

4 California Department of Conservation, *State of California Seismic Hazard Zones, Los Angeles Quadrangle* Map, March 1999, available at: http://gmw.consrv.ca.gov/shmp/download/pdf/ozn_la.pdf, accessed: April 20, 2011.

5 City of Los Angeles Department of City Planning, Environmental and Public Facilities Maps, *Areas Susceptible to Liquefaction* Map, September 1996.

TABLE 3.5-1
EXPANSION POTENTIAL DEFINITIONS

EI	Expansion Potential
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

Source: Group Delta Consultants, Inc., March 2011.

The proposed building areas of the project site typically have a surface layer of up to approximately two feet of clay topsoil, underlain by sands and silty sands. Two samples consisting of a blend of auger cuttings, including the clay and silty sand, in the upper five feet of soil were tested and determined to have EI values of 7 and 10. A third sample consisting of the clay material determined to have an EI value of 57. According to the definitions presented in Table 3.5-1, the two samples consisting of a blend of materials in the upper five feet are classified as having Very Low expansion potential, whereas the near surface clay material is classified as having Medium expansion potential.

LANDSLIDES

Landslides may be triggered by earthquakes, rainstorms, or construction-related activities (e.g., improper grading, structural design, landscaping, etc.). According to the California Geological Survey, the project site is not located in an area identified as being at risk for earthquake-induced landslides.[6] Additionally, the project site is not located within a Landslide Inventory or Hillside Area as delineated by the City.[7] There are no known landslides near the project site, nor is the project site in the path of any known or potential landslides.[8]

3.5.2 REGULATORY SETTING

ALQUIST-PRIOLO FAULT ZONING ACT

Following the 1971 San Fernando Earthquake, the State of California passed the Alquist-Priolo Fault Zoning Act in 1972 to address surface rupture hazards to human-occupied structures. The main purpose of this act is to prevent the construction of human-occupied structures along the surface trace of active faults.[9] Under this act, the State Geologist is required to delineate active faults or "regulatory zones",

6 California Department of Conservation, *State of California Seismic Hazard Zones, Los Angeles Quadrangle* Map, March 1999, available at: http://gmw.consrv.ca.gov/shmp/download/pdf/ozn_la.pdf, accessed: April 20, 2011.

7 City of Los Angeles Department of City Planning, Environmental and Public Facilities Maps, *Landslide Inventory & Hillside Areas* Map, September 1996.

8 California Department of Conservation, *Seismic Hazard Zone Report for the Los Angeles 7.5-Minute Quadrangle, Los Angeles County, California*, 1998, available at: http://gmw.consrv.ca.gov/shmp/download/evalrpt/la_eval.pdf, accessed: April 20, 2011.

9 California Department of Conservation, California Geological Survey, Alquist-Priolo Earthquake Fault Zoning Act, available at: http://www.conservation.ca.gov/cgs/rghm/ap/Pages/main.aspx, accessed: April 13, 2011.

known as Earthquake Fault Zones. The Earthquake Fault Zones are identified on maps distributed to affected cities, counties, and state agencies for their use in planning and regulating development projects located within the zones.

Seismic Hazards Mapping Act

The only hazards addressed by the Alquist-Priolo Fault Zoning Act are those related to surface fault rupture, not other earthquake hazards. As such, the State passed the Seismic Hazards Mapping Act in 1990 to address non-surface rupture seismic hazards, which include liquefaction, landslides, and strong seismic ground shaking. Under the Seismic Hazards Mapping Act, the State Geologist is required to identify and map the locations of these secondary seismic hazards.

3.5.3 Environmental Impacts

Thresholds of Significance

As part of the Initial Study (see Appendix A of this EIR), it was determined that the proposed project would not result in impacts related to landslides or soil erosion, and the loss of topsoil. Additionally, as no septic tanks or alternative wastewater disposal systems would be utilized with the proposed project, the Initial Study found that no related impacts would occur. Accordingly, these issues are not further analyzed in this EIR.

In accordance with the CEQA Guidelines, the proposed project would have a significant impact on geology and soils if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
    - Strong seismic ground shaking; or
    - Seismic-related ground failure, including liquefaction.
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site lateral spreading, subsidence, liquefaction, or collapse; or
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

IMPACT ANALYSIS

GEO-1 *The proposed project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving fault rupture, seismic ground shaking, or liquefaction. Impacts would be less than significant.*

The project site is located in proximity to approximately six faults. As such, the proposed project may potentially be subjected to moderate to severe ground shaking in the event of a major earthquake. The risk of hazard is comparable to the risk generally experienced in the surrounding project area. The project site is not located within an Alquist-Priolo Fault Zone, and no active or potentially active faults capable of fault rupture are known to traverse the project site. The Upper Elysian Park and Puente Hills Blind Thrust Faults are located directly below the project site, but the depth to rupture surface is at least 1.86 miles. Thus, potential for fault rupture is considered remote and impacts would be less than significant.

Modern, well-constructed buildings are designed to resist ground shaking through the use of shear walls and reinforcements. All structures included within the proposed project would be required to be designed and constructed in accordance with the latest version of the California Building Code and the Uniform Building Code. Additionally, the proposed project would be designed and constructed in accordance with the recommendations provided in the Geotechnical Investigation prepared for the proposed project (see Appendix E of this EIR). With adherence to all applicable building codes and recommendations in the Geotechnical Investigation, impacts related to ground shaking would be less than significant.

Due to the composition of geologic material in the area (Holocene alluvium) and relatively shallow recorded groundwater levels, the project site is identified by the State and City as being located within an area susceptible to liquefaction. As previously mentioned, the highest historical groundwater levels at the project site are reported at a depth of approximately 20 feet bgs and current groundwater levels are recorded at depths between 25 to 35 feet bgs. However, site-specific investigation shows that the alluvial soils below the highest groundwater levels are very dense sands and hard clays and silts, which are generally considered non-liquefiable. Liquefaction calculations were made to verify liquefaction potential at the project site using data from the Cone Penetration Test, a high groundwater depth of 20 feet bgs, an earthquake Moment Magnitude of 6.6 from the U.S. Geological Survey (USGS) probabilistic deaggregation, and code maximum considered Peak Ground Acceleration of 0.88g.[10] The analysis indicated that the liquefaction potential at the project site is negligible with calculated settlements of 0.05 inches. Therefore, notwithstanding the project site's designation by the State and City, impacts related to liquefaction would be less than significant.

GEO-2 *The proposed project would not be located on an unstable geologic unit. Impacts would be less than significant.*

As previously discussed under GEO-1, the project site is not at risk for impacts related to liquefaction. Due to the density of granular soils at the project site, hazards associated with compaction are negligible.

[10] Peak Ground Acceleration is expressed in "g," which is a unit describing the acceleration due to Earth's gravity, also known as the "g-force."

Additionally, no groundwater or petroleum would be extracted as part of the proposed project. As such, earth materials underlying the project site would not be subject to subsidence or hydrocompaction. Further, the project site is relatively level and static or seismic slope instability, or lateral spreading or ground lurching is not considered a significant hazard to people or structures. Project construction activities would comply with the California Building Code and the Uniform Building Code, as well as recommendations provided in the Geotechnical Investigation for the proposed project. Therefore, impacts related to unstable soils would be less than significant.

GEO-3 *The proposed project would be located on potentially expansive soils. Impacts would be less than significant with mitigation.*

Soil material at the project site includes clay topsoil underlain by sands and silty sands. As previously mentioned, soil samples taken from the project site were found to have Very Low and Medium expansion potential. Expansive soils can expand when wet, resulting in damage to structures, slabs, pavements, and retaining walls. As such, potential for expansion would be considered in final design and construction of the proposed project. The proposed project would be constructed following the State standard of practices for the design and construction of foundations, slabs, and hardscape supported on soils with a Low to Very Low expansion potential and Medium expansion potential provided in the Geotechnical Investigation prepared for the proposed project. In addition, implementation of mitigation measure GEO-A would ensure that impacts related to expansive soils would be less than significant.

3.5.4 Mitigation Measures

GEO-A As Medium expansion potential soils are limited to the upper two feet of the project site, these clayey materials shall be removed from the area within and extending five feet outside the building footprint and used in non-structural areas. Additionally, surficial clayey soils shall be removed in areas proposed for hardscape features. All backfill of clayey soil removed shall have an EI value of less than 20, and the building foundations, slabs, and hardscape shall be designed for Very Low expansion potential. If surficial clayey soils are left in place or recompacted and used as fills below structural elements, any foundations, slabs, or hardscape supported on these materials shall be designed for Medium expansion potential. If footings, slabs, and hardscape are designed for Low to Very Low expansion potential, then any clayey materials (typically the upper two feet) shall be removed, all backfill below these elements shall have an EI value of 20 or less. Unless all clayey topsoils are removed, foundations, slabs, and hardscape shall be designed for Medium expansion potential.

3.5.5 Level of Significance After Mitigation

With implementation of mitigation measure GEO-A, impacts related to geology and soils would be less than significant.

This page is intentionally left blank.