IV.E GEOLOGIC HAZARDS

1. INTRODUCTION

This section identifies and evaluates geologic and soils conditions at the Barlow Respiratory Hospital Project site that could affect, or be affected by, implementation of the proposed Project. This section incorporates and summarizes information contained in the *Update to Preliminary Geotechnical Investigation: Barlow Respiratory Hospital,* prepared by Geocon West, Inc. in April 2010, which is included as **Appendix IV.E** of this Draft EIR.

2. REGULATORY FRAMEWORK

a. Federal Regulations

i. Flood Insurance Rate Maps

Flood Insurance Rate Maps are prepared by the Federal Insurance Administration of the Department of Housing and Urban Development (HUD) after a risk study for a community has been completed and the risk premium rates have been established. The maps indicate the risk premium zones applicable in the community and when those rates are effective. They are used in making floodplain determinations and to determine if a proposed action is located in the base or critical action floodplain, as appropriate.

ii. General Permit for Discharges of Storm Water Associated with Construction Activity

Because the Project site is greater than one (1) acre in size, a General Permit for Discharges of Storm Water Associated with Construction Activity is required by the Los Angeles Regional Water Quality Control Board (LARWQCB), as part of the National Pollution Discharge Elimination System (NPDES), to control erosion and pollution during construction of the Project. The permit requires the applicant to prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) to be administered throughout Project construction. The SWPPP must list Best Management Practices (BMPs) that the discharger (applicant) will use to protect storm water runoff.

b. State Regulations

i. Seismic Hazards Mapping Act

The State of California passed the Seismic Hazards Mapping Act of 1990[1] (Public Resources Code Section 2690-2699) to address the risks associated with seismic events, such as strong ground shaking, liquefaction, landslides, and other ground failures. Under the Act, the State Geologist is responsible for identifying and mapping seismic hazard zones as part of the California Geological Survey. The California Geological Survey maps non-surface rupture earthquake hazard zones (including liquefaction and seismically induced landslides) for use by local governments for planning purposes. These maps are intended to protect the public from the risks involved with strong ground shaking, liquefaction, landslides or other ground failure, and other hazards caused by earthquakes. For projects within seismic hazard zones, the Seismic Hazards Mapping Act requires developers to conduct geological investigations and incorporate appropriate mitigation measures into project designs before building permits are issued. Most of the Southern California region has been mapped.

ii. Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act[2] (APEFZ, or the Act) (Public Resource Code Section 2621.5) of 1972 was enacted in response to the 1971 San Fernando earthquake, which caused extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act, which has since been amended 10 times, establishes policies and criteria to assist in the siting of buildings near active faults, or those that demonstrate surface displacement within the last 10,000 years.

The Act requires that geologic studies be conducted to locate and assess any active fault traces[3] in and around known active fault areas prior to development of buildings for human occupancy. The APEFZ only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. The law requires the State Geologist to establish regulatory zones (Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps of these zones, known as Alquist-Priolo Maps, to all affected cities, counties, and state agencies for their use in

1 California Public Resources Code-Section 2690–2699.6: "Seismic Hazards Mapping Act,"

2 California Public Resources Code, Section 2621.5, "Alquist-Priolo Earthquake Fault Zoning Act."

3 A surface trace, also referred to as a fault trace or surface rupture, is the usually linear surface expression of the intersection of a fault plane with the Earth's surface. Surface traces may be marked by visible horizontal or vertical displacement of the underlying rock and soil units on either side, abrupt elevation differentials, the emergence of springs, or other indicative features.

planning and controlling new or renewed construction. Local cities and counties must regulate certain development projects within the Earthquake Fault Zones, generally by issuing building permits only after geologic investigations demonstrate that development sites are not threatened by future surface displacement. Projects subject to these regulations include all land divisions and most buildings intended for human occupancy.

iii. California Building Code

The California Building Standards Code (CBC) has been codified in the California Code of Regulations Title 24, Part 2. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for administering the CBC, including adopting, approving, publishing, and implementing codes and standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to establish minimum standards for safeguarding public health, safety, and general welfare through structural strength, means of egress facilities, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction.

The CBC is based on the International Building Code, with the addition of necessary California amendments based on the American Society of Civil Engineers Minimum Design Standards 7-05. The California Building Standards Code establishes requirements for general structural design and methods for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion in building codes. The provisions of the California Building Standards Code apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California. The 2007 CBC is based on the 2006 International Building Code.

Earthquake design requirements take into account the occupancy category of a structure, site class, soil classifications, and various seismic coefficients, which are used to determine the appropriate Seismic Design Category for a project. The Seismic Design Category is a classification system that combines occupancy categories with the level of expected ground motions at the site and ranges from Seismic Design Category A (very small seismic vulnerability) to Seismic Design Category E/F (very high seismic vulnerability and near a major fault). Design specifications for the structure are then determined according to the applicable Seismic Design Category.

iv. Hospital Facilities Seismic Safety Act

As a result of the 1994 Northridge earthquake, which caused extensive structural damage to hospitals throughout the Los Angeles region and necessitated the closure of 11 facilities, the State signed Senate Bill (SB) 1953, the Hospital Facilities Seismic Safety Act, into law in September 1994. This legislation directed all hospitals in California to comply with three seismic building code safety requirements by specific deadlines, as follows:[4]

- **By 2002**: Major non-structural systems such as backup generators, exit lighting, etc. were required to be braced

- **By 2008**: All general acute care inpatient buildings at risk of collapsing during a strong earthquake are required to be rebuilt, retrofitted or closed.

- **By 2030**: All hospital buildings in the state are required to be able to be operational following a major earthquake.

The legislation was estimated at the time of its passage to affect approximately 2,700 general acute care inpatient hospital buildings at approximately 470 hospitals statewide, at a projected cost of approximately $24 billion.[5] As of 2007, it was estimated that 60 percent of hospitals in Southern California were noncompliant, including 58 hospitals in Los Angeles County. Hospitals were given several interim deadlines and opportunities for possible extensions to comply with the requirements.

- **By January 1, 2001:** Hospitals were required to file reports documenting their building status with the Office of Statewide Health Planning and Department (OSHPD). A one-year extension for compliance was granted if requested.

- **By January 1, 2002:** All general acute care inpatient hospital buildings were required to meet specific requirement for bracing nonstructural building elements as well as install brace systems for communications, emergency power, bulk medical gas and fire alarms.

- **By January 1, 2008*:*** All general acute care inpatient hospital buildings must meet at least certain requirements to brace structural and nonstructural building elements so as not to pose a risk of collapsing in a major earthquake. Meeting these requirements would allow

4 SB 1953, Hospital Facilities Seismic Safety Act, Chapter 740, Statutes of 1994.

5 California Healthcare Association, SB 1953 Hospital Facilities Seismic Safety Fact Sheet, [n.d.]. http://www.calhealth.org/public/press/Article%5C103%5CSB1953factsheet%20-%20Final.pdf

hospital buildings to remain operational until 2030. Nonstructural mechanical, electrical and plumbing systems, including fire sprinkler branch lines, are required to be braced and anchored in critical-care areas such as surgery, intensive care, pharmacy, central supply, emergency department and radiology. Rural hospitals in Seismic Zone 3 have been given until 2013 to brace fire sprinkler systems.

– A five-year extension until January 1, 2013 to comply with the structural and nonstructural bracing requirements is available to hospitals that demonstrate they will be able to fully meet 2030 requirements by 2013, so that hospitals are not obligated to retrofit facilities they plan to replace shortly thereafter.

– A 22-year extension to January 1, 2030 is available for some non-structural bracing requirements for hospitals in Seismic Zone 3, if they meet certain geotechnical engineering report criteria.

- **January 1, 2030:** All general acute care inpatient buildings are required to be in substantial compliance with SB 1953 by this date, and buildings must be classified as Seismic Retrofit Program (SPC)-3, 4, or 5, and have braced all structural and nonstructural building elements and equipment.

Subsequent to the passage of SB 1953, SB 1661 was passed authorizing an additional extension for compliance with SB 1953 of up to two years until January 1, 2015. The extension effectively allows hospitals that are planning replacement facilities to continue operations until January 1, 2015, if all of the following circumstances have been met:

- An application for an extension to the January 1, 2013 deadline has already been granted by OSHPD;
- A building permit application was made to OSHPD by January 1, 2009;
- The permit is granted by January 1, 2011;
- Contractor identification and project schedule are submitted by January 1, 2011;
- Correction construction is underway at the time of the permit application submittal;
- Acute care uses are planned to continue at the facility in question, post-project implementation; and

- Approval of the application for extension is granted by OSHPD.

In addition to seismic safety needs, the age of the average hospital in California is between 45 and 50 years old. Many hospitals are therefore operating in outdated facilities or with outdated technologies, which constrains the ability to meet patient care demand, including infection control and other patient safety considerations.

c. Regional and Local Regulations

i. City of Los Angeles General Plan

The Safety Element of the City of Los Angeles General Plan addresses the protection of building occupants and equipment during seismic events. Specific guidelines require the evaluation of liquefaction risk, seismicity hazards, fault rupture zones, and the provision of engineering investigation reports. The City's Emergency Operations Organization, which comprises a number of City agencies, administers policies and provisions contained within the Safety Element that address geologic and seismic hazards. Accordingly, the Safety Element goals, objectives, and policies are broadly stated to reflect the comprehensive scope of the Emergency Operations Organization. Project compliance with General Plan Safety Element policies is evaluated in **Section IV.H**, Land Use.

ii. City of Los Angeles Building Code

The City of Los Angeles also regulates building design in specific geologic hazard areas in the City of Los Angeles through the Los Angeles Building Code. The Los Angeles Building Code adopts the CBC by reference and makes further building design regulations for special hazard areas. These documents include specific requirements for construction, grading, excavations, slope stability, use of fill and foundation work, including type of materials, geologic investigations and reports, soil and rock testing, groundwater, and seismic design and procedures, which are intended to limit the probability of occurrence and the severity of consequences from geological hazards. The City Department of Building and Safety is responsible for implementing the provisions of the Building Code and Grading Standards.

3. EXISTING CONDITIONS

a. Regional and Local Geologic Setting

The Project site consists of two irregular-shaped partially terraced hillside parcels located along the east and west side of Stadium Way and within Chavez Ravine. The site is bounded by Scott Avenue and a vacant hillside slope to the north; by Boylston Street and vacant hillside slope to the east; by Elysian Park Avenue, a vacant hillside slope and a vacant dirt lot to the south; and by Elysian Park Drive and various single-family residences to the west.

The eastern Project site is currently occupied by the existing Barlow Respiratory Hospital and associated uses, consisting of approximately 23 small single-story buildings, one somewhat larger single-story structure, two two-story structures, and the two-story hospital along with paved parking lots and various civil structures. The eastern Project site consists of a hillside area that slopes down to the west, south, and south east at approximate gradients of 5:1 to 2:1 (horizontal to vertical) within the northeast and eastern portions of this part of the Project site and gently slopes to the south within the western and southwestern portions. There is approximately 89 feet of total relief across the eastern Project site. Vegetation on the site consists of grasses, shrubs, and trees located throughout the parcel.

The western Project site developed with seven single-story mixed-use/dormitory structures close to Stadium Way and two two-story single-family residences near the western edge of the Project site along Elysian Park Drive. The hillside area slopes down to the northeast and east toward Stadium Way at approximate gradients of 2:1 to locally 1.5:1 throughout the majority of the western slope and becomes shallower to an approximate gradient of 7:1 along the eastern edge of the parcel or the toe of the slope. There is approximately 142 feet of total relief across the western Project site.

b. Soil and Geologic Conditions

The earth materials underlying the Project site consist of artificial fill, alluvium, and colluvial soils underlain by sedimentary bedrock units of the Miocene Age Puente Formation. The Project site also straddles the east and west side of the Chavez Ravine located within the southern portion of the Elysian Park Hills. The Elysian Park–Repetto Hills area consists of northwest/southeast-trending uplifted hills along the northeast edge of the Los Angeles Basin. The Los Angeles River flows within a floodplain channel between the Elysian Park Hills and the Repetto Hills flowing southward toward the Los Angeles Basin. The Arroyo Seco flows through the Repetto Hills just south of Mt. Washington and joins the Los Angeles River near the southeastern edge of the Elysian Park Hills.

The Elysian Park Hills and the Repetto Hills are predominantly composed of Miocene Age soft sedimentary bedrock incised by elevated flood plain and uplifted alluvial valley deposits, as seen in **Figure IV.E-1**, *Regional Geologic Map*.

i. Artificial Fill

The Project site is partially mantled by a layer of artificial fill. The artificial fill generally consists of loose to medium dense and soft to stiff, dry to moist, dark reddish brown to yellowish brown silty sand, sandy silt, silt, and clay with varying amounts of bedrock fragments, gravel, and construction debris. The fill was encountered to depths up to nine feet below the surface and is believed to be the result of past grading and demolition activities at the Project site. Deeper fill may occur between borings and on other parts of the Project site that were not directly explored.

ii. Alluvium

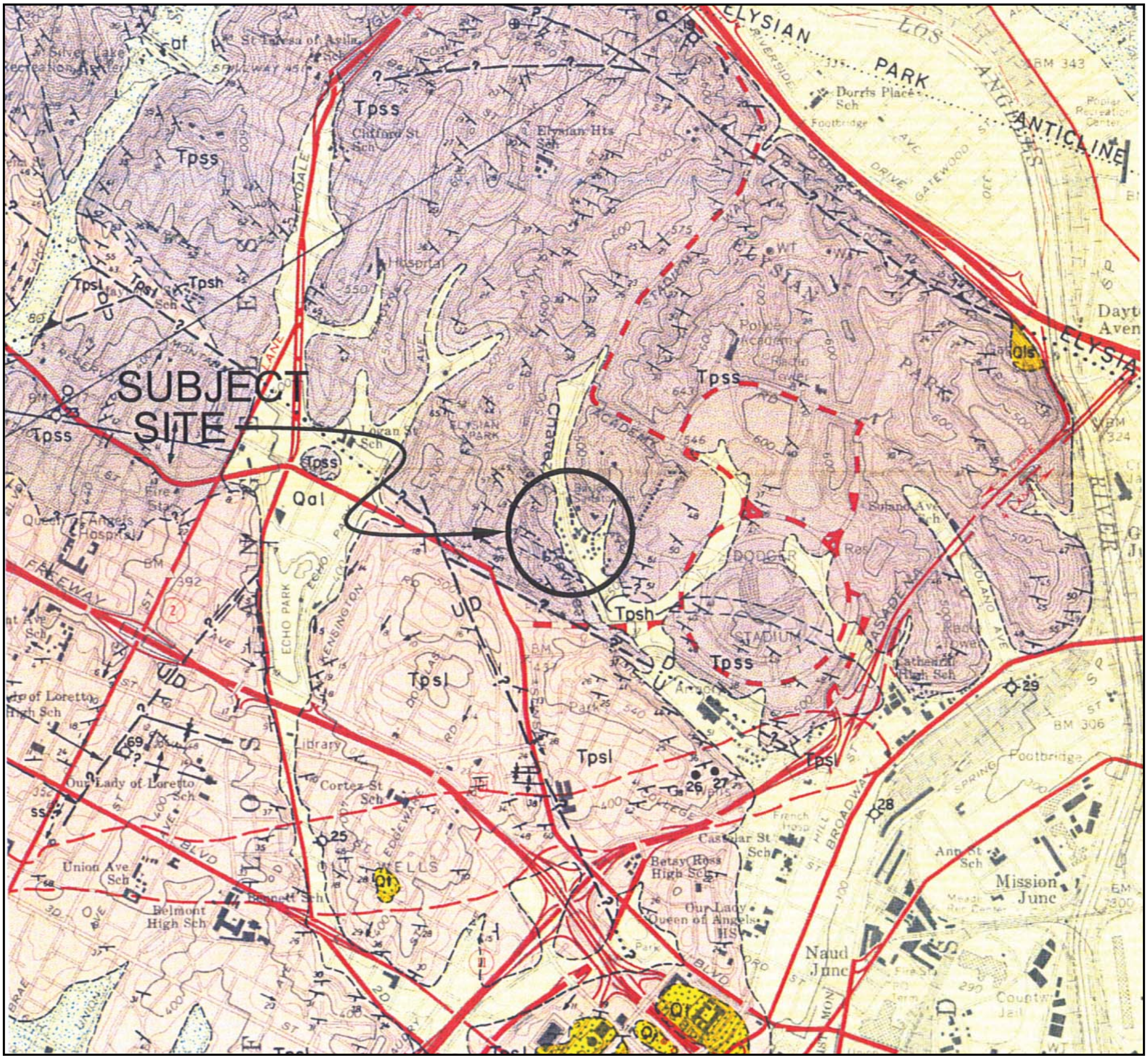
The artificial fill is partially underlain by alluvial deposits derived the surrounding Elysian Park Hills. Alluvial deposits were encountered in the northern portion of the western Project site (Borings 1, 2, and 8) at depths between one and 45.5 feet below ground surface. The alluvium generally consists of soft to stiff and loose to medium dense, yellowish brown to reddish brown silty sand, sandy silt, silt and clay with varied amounts of bedrock fragments.

iii. Colluvium

The artificial till and alluvium is partially underlain by colluvial deposits derived from the in-situ weathering and movement of the underlying bedrock. The colluvial deposits were encountered on the majority of the eastern parcel and the northeastern and northwestern portions of the western Project site (Test Pits 1 and, 3 through 11, and in Borings 1, 2, 3, 6, 7, and 8) ranging from the ground surface and 22.5 feet below ground surface. The colluvium generally consists of soft to stiff and loose to medium dense, yellowish brown to reddish brown silty sand, sandy silt, and silt with varied amounts of bedrock fragments.

iv. Puente Formation

The artificial fill, alluvium, and colluvium are underlain by sedimentary bedrock units of the Miocene Age Puente Formation. The bedrock consists of interbedded yellowish brown, well-bedded, fine-grained sandstone, and yellowish brown to olive brown, well-bedded siltstone. The bedrock is slightly to moderately weathered, slightly fractured and is moderately inclined to the



LEGEND

Qal: Younger Alluvium

Qalo: Older Alluvium

Tpss: Puente Formation (sandstone with siltstone interbeds)

Tpsl: Puente Formation (siltstone)

Tpsh: Puente Formation (shale)

58 Strike and dip of bedding

N

0 2100 4200

Scale (Feet)

Source: Lamar, D.L., 1970, Geology of the Elysian Park-Repetto Hills Area, Los Angeles County, CA – November 2008.

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Figure IV.E-1
Regional Geologic Map

southwest. The strike of the bedrock in the Project site vicinity ranges from north 34 degrees west to north 65 degrees west, with dips of 40 degrees to 55 degrees to the southwest, which is consistent with regional trends.

c. Groundwater

According to the Seismic Hazard Evaluation of the Los Angeles 7.5 Minute Quadrangle, the Project site is not located within a groundwater basin. Borings encountered groundwater within the alluvial deposits in lower elevations at the center of the Project site, which occupies a small north-south trending valley infilled by a wedge of permeable alluvial deposits underlain by bedrock. Groundwater on the Project site ranges from five feet to 39 feet below the surface, and is considered to represent a perched (confined) groundwater condition, not hydrologically connected to a regional groundwater source. Groundwater is continually recharged by an influx of groundwater and runoff from surrounding hillside areas.

Groundwater was not encountered in the higher elevation areas along the eastern and western Project sites that are underlain by shallow bedrock, since bedrock is considered non-water bearing due to the impermeability of the bedrock. As such, groundwater is not expected within these areas unless it is generated by runoff and seepage. However, it has been reported that groundwater is periodically observed seeping into the basement level of the main hospital structure. The main hospital structure is situated on the lower portions of the site within the alluvial deposits. The presence of groundwater is likely due to the presence of the north-south trending valley that runs through the center of the site parallel to Stadium Way. The small valley is infilled with a wedge of permeable alluvial deposits underlain by impermeable bedrock. Groundwater filters through the permeable alluvial deposits and is continually recharged through the influx of groundwater and runoff from the surrounding hillside areas.[6]

d. Geologic Hazards

i. Surface Fault Rupture

The numerous faults in Southern California include active, potentially active, and inactive faults. These major groups are based on criteria developed by the California Geological Survey (formerly known as California Division of Mines and Geology (CDMG)) for the Alquist-Priolo Earthquake Fault Zone Program. An active fault is one that has had surface displacement within Holocene time (about the last 11,000 years). A potentially active fault has demonstrated surface displacement during

[6] Geocon West, Inc., *Update to Preliminary Geotechnical Investigation: Barlow Respiratory Hospital*, April 2010.

Quaternary time (approximately the last 1.6 million years), but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

Faults in the vicinity of the Project site are shown in **Figure IV.E-2,** Regional Fault Map. **Figure IV.E-3**, *Southern California Seismicity Map*, shows the locations of major faults and selected earthquake epicenters in Southern California. **Table IV.E-1**, *Known Faults Near the Project Site,* shows the closest known faults. The Project site is not within a currently established Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards.[7] No active or potentially active faults bisect the Project site.

The closest surface projection of an active fault is the Hollywood Fault located approximately 3.3 miles north of the Project site. Other nearby active faults are the Raymond Fault, the Verdugo Fault, the Newport-Inglewood Fault Zone, and the Santa Monica Fault located 3.6 miles north, 5.4 miles north-northeast, 7.0 miles southwest and 9.5 miles west of the site, respectively. The active San Andreas Fault zone is located approximately 33 miles northeast of the Project site. The Project site, however, is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults.

The closest potentially active fault to the site is the MacArthur Park Fault located approximately 1.2 miles southwest of the Project site. Other nearby potentially active faults are the Coyote Pass Fault, the Overland Fault, and the Charnock Fault located 3.0 miles southeast, 9.5 miles west-southwest and 10.5 miles west-southwest of the site, respectively.

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Los Angeles Basin. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 magnitude 5.9 Whittier Narrows earthquake and the January 17, 1994 magnitude 6.7 Northridge earthquake were a result of movement on the buried thrust faults. The Project site is located within the vertical projection of the planes of both the Upper Elysian Park Thrust and the Los Angeles Segment of the Puente Hills Blind Thrust Fault. These thrust faults are not exposed at the surface and do not present a potential surface fault rupture hazard; however, these active features are capable of generating future earthquakes.

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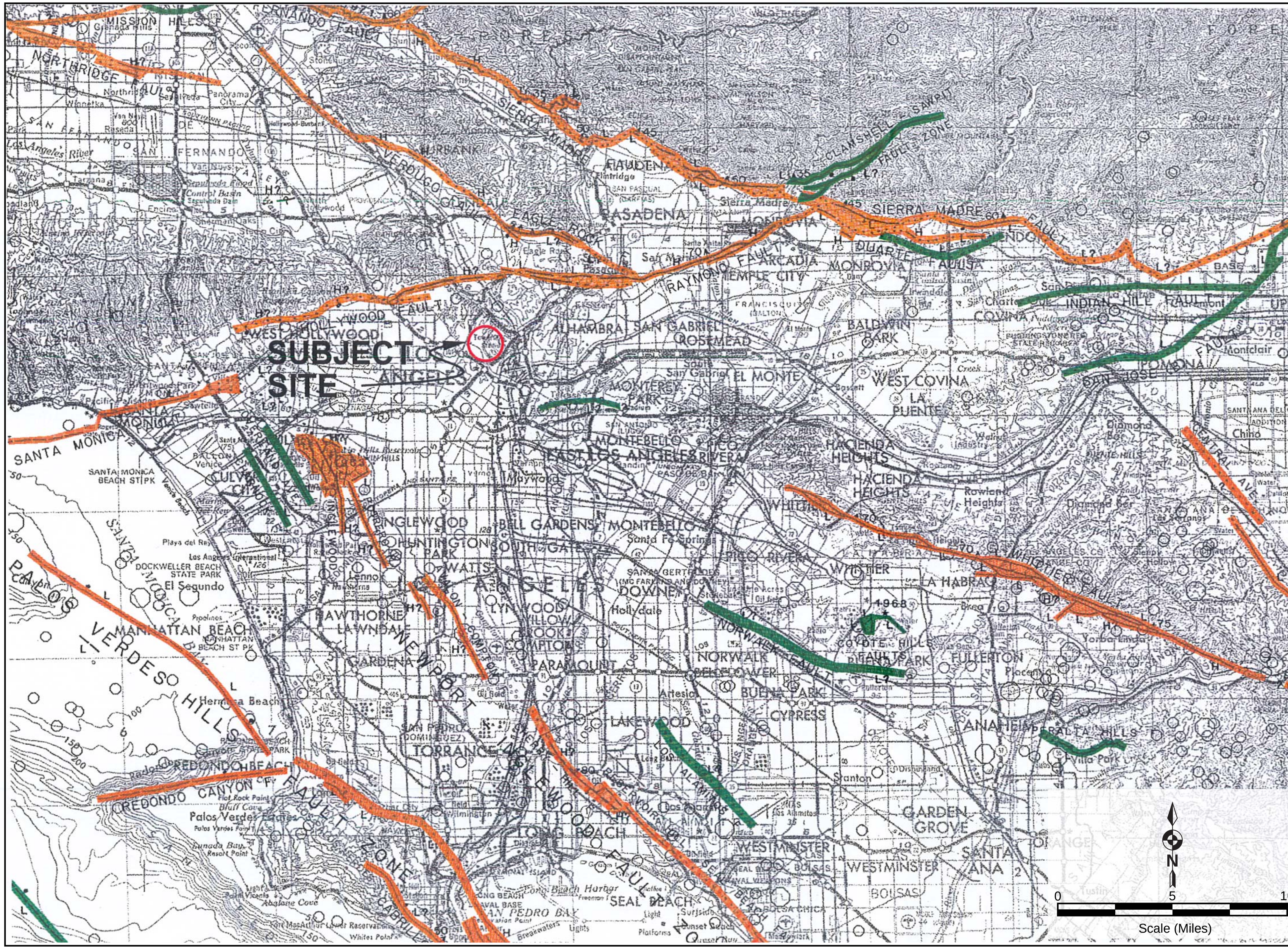
7 Geocon West, Inc., *Update to Preliminary Geotechnical Investigation: Barlow Respiratory Hospital*, (2010) 6.



LEGEND

Potentially Active Faults

Active Faults

Epicenters of Earthquakes 1978-1984

5.0 - 5.9

4.0 - 4.9

3.0 - 3.9

2.0 - 2.9

Source: Lamar, D.L., 1970, Geology of the Elysian Park-Repetto Hills Area, Los Angeles County, CA – November 2008.

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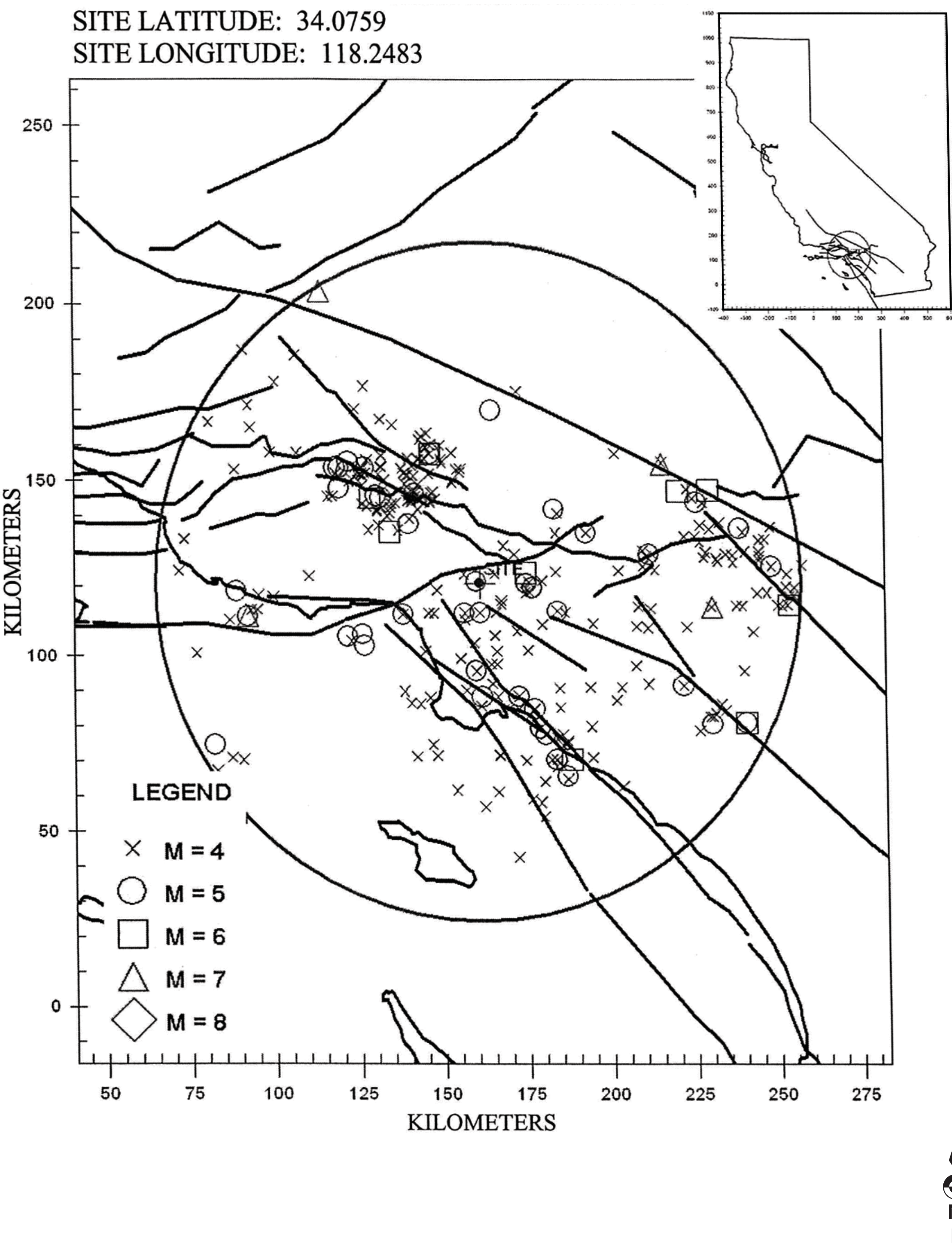
Figure IV.E-2
Regional Fault Map



Source: Geocon Inland Empire, Inc., Preliminary Geotechnical Investigation, Barlow Respiratory Hospital – 2008.

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Figure IV.E-3
California Seismicity Map

Table IV.E-1
Known Faults Near the Project Site

Fault Name	Distance from Project Site (miles)	Direction from Project Site
Active Faults		
Hollywood Fault	3.3	North
Raymond Fault	3.6	North
Verdugo Fault	5.4	North-Northeast
Newport-Inglewood Fault Zone	7.0	Southwest
Santa Monica Fault	9.5	West
San Andreas Fault Zone	33	Northeast
Potentially Active Faults		
MacArthur Park Fault	1.2	Southwest
Coyote Pass Fault	3.0	Southeast
Overland Fault	9.5	West-Southwest
Charnock Fault	10.5	West-Southwest

Source: Geocon West, Inc., Update to Preliminary Geotechnical Investigation: Barlow Respiratory Hospital, (2010). Table 1.

ii. Seismicity

As with all of Southern California, the Project site has experienced historic earthquakes from various regional faults. The epicenters of recorded earthquakes with magnitudes equal to or greater than 4.0 within a radius of 60 miles of the site are depicted on **Figure IV.E-3**.

The seismic exposure of the site may be investigated in two ways. The deterministic approach recognizes the Maximum Earthquake, which is the theoretical maximum event that could occur along a fault. The deterministic method assigns a maximum earthquake to a fault derived from formulas that correlate the length and other characteristics of the fault trace to the theoretical maximum magnitude earthquake. The probabilistic method considers the probability of exceedance of various levels of ground motion and is calculated by consideration of risk contributions from regional faults.

iii. Deterministic Analysis

Based on the results of the deterministic analysis, the maximum earthquake resulting in the highest peak horizontal accelerations at the Project site would be a magnitude 6.4 event on the Upper Elysian Park Thrust Fault. Such an event would be expected to generate peak horizontal accelerations at the site of 1.31g.[8] The site could be subject to moderate to severe ground shaking in

8 *g* is defined as the ground acceleration produced from an earthquake.

the event of a major earthquake on any fault within Southern California. With respect to seismic shaking, the Project site is considered comparable to the surrounding developed area.

iv. Probabilistic Analysis

The Design-Basis Earthquake Ground Motion (DBE) is the level of ground motion that has a ten percent chance of exceedance in 50 years, with a statistical return period of 475 years. The Maximum Considered Earthquake ground motion (MCE) is the level of ground motion that has a two percent chance of exceedance in 50 years, with a statistical return period of 2,500 years. Based on the results of the probabilistic analysis, the DBE and MCE are expected to generate motions at the site of approximately 0.83g and 1.25g, respectively.

v. Liquefaction

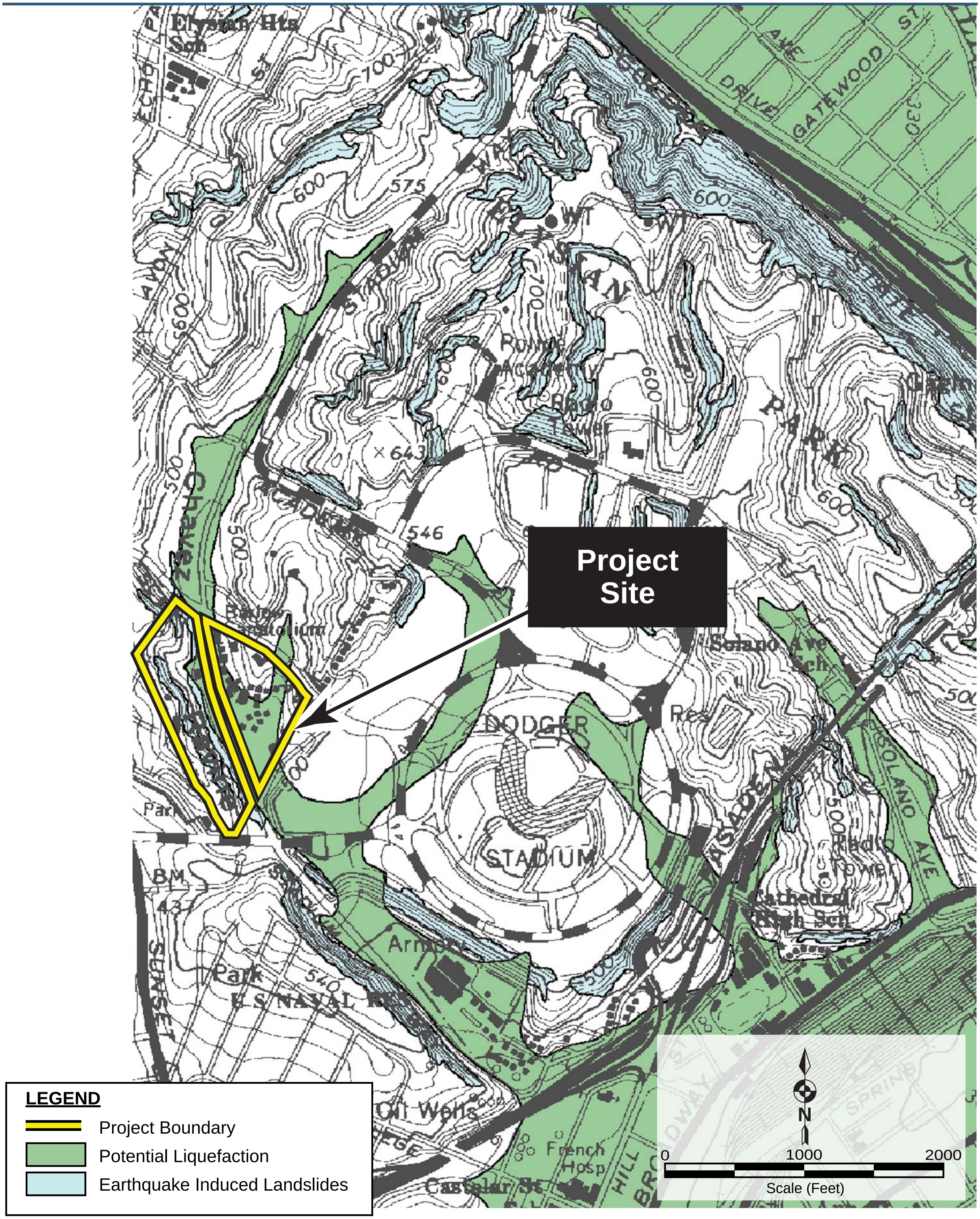
Liquefaction involves a sudden loss in strength of saturated, cohesionless soils that are subject to ground vibration and results in temporary transformation of the soil to a fluid mass. If the liquefying layer is near the surface, the effects are much like that of quicksand for any structure located on it. If the layer is deeper in the subsurface, it may provide a sliding surface for the material above. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sand soil. In addition, ground acceleration and duration of an earthquake must also be of a significant level to induce liquefaction.

According to the County of Los Angeles Seismic Safety Element and the City of Los Angeles Seismic Safety Element, the Project site is not within an area identified as having a potential for liquefaction. However, as **Figure IV.E-4**, *Project Site Seismic Hazard Zones*, indicates, the portions of the Project site adjacent to Stadium Way are designated as "liquefiable." These areas are underlain by permeable alluvial deposits where groundwater was encountered at depths between nine and 20 feet below grade. Therefore, there is potential for liquefaction to occur in these portions of the Project site.

Liquefaction analysis indicates that the soils on the Project site could be prone to approximately 6.2 inches of settlement in the deepest areas of alluvium during a 475-year return period ground motion, which could result in settlement of approximately 4 inches at grade.

vi. Seismically-Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of dry and loose sands. Based on historic high groundwater table of



Source: California Geological Survey, Seismic Hazards Zone Map, Los Angeles Quadrangle – 1999.

Figure IV.E-4
Project Seismic Hazard Zones

five feet below the surface, dynamic compaction of the alluvial deposits is considered to be negligible. Based on the dense and well consolidated nature of the bedrock underlying the site, appreciable seismically-induced settlements are not expected.

vii. Slope Stability and Landslides

According to the Los Angeles County Seismic Safety Element and the City of Los Angeles Safety Element, the Project site is not within an area identified as having a potential for slope instability. However, as **Figure IV.E-4** indicates, portions of the western Project site are located within an area identified as having a potential for seismic slope instability.

The Project site encompasses two partially terraced hillside parcels situated along the east and west side of a small north-south trending soil infilled valley which runs through the center of the Project site. The eastern Project site consists of a hillside area that slopes down to the west, south, and southeast at approximate gradients of 5:1 to 2:1 (horizontal to vertical) within the northeast and eastern portions of the parcel and gently slopes to the south within the western and southwestern portions of the eastern Project site. There is approximately 89 feet of total relief across the eastern Project site.

The western Project site consists of a hillside area which slopes down to the northeast and east toward Stadium Way at approximate gradients of 2:1 to 1.75:1, becoming shallower near the toe of the slope, where the gradient is approximately 7:1. There is approximately 142 feet of total relief across the western Project site.

The bedrock underlying the Project site consists of well-bedded siltstone and sandstone of the Miocene Age Puente Formation. In the vicinity of the Project site, the bedrock is generally oriented north 36 degrees west to north 60 degrees west with dips of 32 to 57 degrees downward to the southwest.

Along the eastern Project site, the orientation of the bedding with respect to the existing south, southwest, and west-facing slopes is considered favorable with respect to gross stability. Additionally, the orientation of the bedding on the western Project site is also considered favorable with respect to gross stability.

viii. Flooding, Erosion, Runoff, and Sedimentation

The Project site is located in a "Zone C" flood hazard area. As defined by the Federal Insurance Administration, "Zone C" is an area of minimal flooding.

Winter storms typically occur between November and April and result in sharp peak flows over a period of several hours. The shallow groundwater table exists within the central portion of the Project site and is fed by continued influx of groundwater and runoff from the surrounding hillside areas.

Small-scale localized erosional activity has been observed along the various slope faces of the Project site. The bedrock units are slightly to moderately resistant to erosion. Small and shallow erosion-related incisions in the upper drainages and along the slopes are present.

Significant portions of the slope areas within the Project site have not been subject to development nor have been covered by pavement and impervious surfaces. Due to the absence of major drainage paths within the Project site, large-scale sedimentation is not expected to occur.

ix. Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Based on a review of the Los Angeles County Seismic Safety Element, the Project site is not located within an area of potential inundation. The probability of earthquake-induced inundation is considered very low. See **Section IV.G**, *Hydrology and Water Quality,* for discussion and analysis of the potential for Project flooding from tsunamis and seiches.

x. Mineral Resources, Oil Field, and Methane Potential

The alluvial deposits underlying the Project site are not suitable as a potential source of aggregate. Additionally, the site is not within an area of historic aggregate production.

According to the California Division of Oil, Gas and Geothermal Resources (DOGGR), the Project site is not located within the boundaries of an oilfield. No oil wells are located in the immediate vicinity of the Project site. However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map.

Since the Project site is not in an area of current or historical aggregate mining and is outside the limits of an active or historic oil field, development of the site would not result in the loss of potential aggregate or petroleum resources; the loss of potential mineral resources is considered negligible. The Project site is not located within a Methane Zone or Methane Buffer Zone as defined by the City of Los Angeles.

xi. Subsidence, Hydro-Consolidation, and Peat Oxidation

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The area surrounding the Project site is not within an area of known ground subsidence. No large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the Project site.

The majority of the Project site is underlain by bedrock or alluvial/colluvial soil. The bedrock would not be subject to hydro-consolidation. Hydro-consolidation is the tendency of a soil structure to collapse upon saturation resulting in the overall settlement of the affected soils and any overlying foundations or paving supported therein. Some of the alluvial/colluvial soil is compressible and a potential for settlement due to hydro-consolidation and/or ongoing general consolidation exists. A relatively shallow groundwater table exists within the central portion of the Project site, which is part of Chavez Ravine, and is likely due to the continued influx of groundwater and runoff from the surrounding hillside areas. The existence of shallow groundwater may limit the amount of remedial grading, resulting in some of the settlement-prone soils being left in place.

Oxidation of peat deposits can result in a corresponding loss of volume, creating a potential for settlement in areas where structures or compacted fill are planned. Peat deposits were not encountered during the geotechnical investigation, and are not expected given the geomorphology of the site. Therefore, the probability of hazards associated with peat oxidation is considered very low.

xii. Corrosive Soils

Corrosive soils are those soils that have a high pH, soluble salt content, or other soil characteristic with the potential to corrode metal and concrete upon contact under certain conditions.[9] Project site soils were tested for pH, resistivity, and chloride content and were found to be potentially corrosive, which could adversely affect underground utilities and other building materials, particularly in the presence of high soil moisture levels.

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9 A major factor in determining soil corrosivity is electrical resistivity. Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

Soils were also tested for their water-soluble sulfate content, since such soils can result in reduced durability in hardened cement. The potential for exposure of building materials to water-soluble sulfate-containing soils (i.e., the potential for sulfate exposure) was determined to be negligible.

xiii. Volcanic Hazards

The Project site is not subject to any known volcanic hazards. The nearest Quaternary age volcanic fields are located about 120 miles to the north near Little Lake and the Coso Mountains. Another area of recent volcanic activity is located about 105 miles to the northeast at Amboy and Pisgah Craters.

4. IMPACT ANALYSIS

a. Methodology

Analysis of potential Project impacts related to geologic hazards is based on the information contained in the *Update to Preliminary Geotechnical Investigation* prepared by Geocon West, Inc., April 15, 2010, which is included as **Appendix IV.E** of this Draft EIR. The study included the following elements:

- Review of prior geotechnical reports;
- Visual surface reconnaissance of the site;
- A field investigation;
- Laboratory testing and engineering analysis performed on selected soil samples obtained from subsurface explorations;
- Review of aerial photographs;
- Review of regional geologic and published geologic reports;
- Geologic mapping and subsurface exploration, including seven borings drilled using a 24-inch-diameter truck-mounted bucket auger drilling machine, one 7-inch-diameter boring utilizing a truck-mounted hollow-stem auger drilling machine, and 11 test pits utilizing a 4x4 rubber tire backhoe; and
- Laboratory testing and engineering analysis performed on selected soil samples obtained from subsurface explorations.

b. Significance Thresholds

Appendix G of the State *CEQA Guidelines* provides sample checklist questions for use in an Initial Study to determine a project's potential for environmental impacts. According to the questions contained in Appendix G under Section VI, Geology and Soils, a project would have a significant impact if it would:

VI. a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i. 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 (refer to Division of Mines and Geology Special Publication 42)

ii. Strong seismic ground shaking

iii. Seismic-related ground failure, including liquefaction

iv. Landslides

VI. b) Result in substantial soil erosion or the loss of topsoil;

VI. 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 on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;

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

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

The *City of Los Angeles CEQA Thresholds Guide* states that a project would normally have a significant impact with respect to geology if it:

- Would cause or accelerate geologic hazards, which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury;

- Would constitute a geologic hazard to other properties by causing or accelerating instability from erosion;
- Would accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on site; or
- Would have one or more distinct and prominent geologic or topographic features destroyed, permanently covered, or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hill slopes, canyons, ravines, rock outcrops, water bodies, streambeds, and wetlands.

The more specific thresholds used in the *City of Los Angeles CEQA Thresholds Guide* to determine significant geological impacts incorporate the general checklist questions contained in Appendix G of the State *CEQA Guidelines*. Therefore, based on the *City of Los Angeles CEQA Thresholds Guide*, the proposed Project would have a significant impact with respect to geology if:

GEO-1 The Project would cause or accelerate geologic hazards, which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury;

GEO-2 The Project would constitute a geologic hazard to other properties by causing or accelerating instability from erosion;

GEO-3 The Project would accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on site; or

GEO-4 The Project would have one or more distinct and prominent geologic or topographic features destroyed, permanently covered, or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hill slopes, canyons, ravines, rock outcrops, water bodies, streambeds, and wetlands.

c. Project Design Features

The applicant has structured a plan for hospital replacement and development of the rest of the Project site. The proposed Project would be implemented in phases, beginning with the replacement hospital and associated administration and support building by January 1, 2013, in order to meet deadlines set by the Office of Statewide Health Planning and Development. The remainder of the proposed Project, including the skilled nursing facility, adaptive reuse of existing buildings to remain in the proposed Historic Parcel adjacent to the replacement hospital, and residential and commercial uses on the remaining 13 proposed parcels, would be constructed in subsequent phases. Project buildout is expected to occur by 2022.

Project-level geotechnical evaluations would be required prior to finalizing grading and construction plans for individual Project buildings. Project buildings would be designed and constructed in accordance with all applicable requirements. These include those requirements outlined in the most current addition of the CBC and the Los Angeles Uniform Building Code, including all applicable provisions of Chapter IX, Division 70 of the Los Angeles Municipal Code (LAMC) which addresses grading, excavations and fills. Design and construction would also adhere to applicable requirements of the Department of the State Architect and federal building code requirements. Mitigation is identified in this section to ensure that project construction and operation adheres to these requirements as well as to the recommendations contained in the programmatic-level *Geotechnical Investigation* contained in **Appendix IV.E** of this Draft EIR. Project-level hydrology plans will also be required prior to finalizing grading, drainage, and construction plans for individual Project buildings.

d. Project Impacts

i. Geologic Hazards

GEO-1 Would the Project cause or accelerate geologic hazards, which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury?

As stated in the *Geotechnical Investigation* contained in **Appendix IV.E,** Project-level (i.e., building-specific) geotechnical investigations will be required prior to finalizing grading and construction plans for individual proposed Project buildings and walls. Buildings proposed for implementation under the proposed Project would then be designed and constructed in accordance with all applicable requirements contained in the most current editions of the CBC and the Los Angeles Uniform Building Code, as well as applicable provisions of Chapter IX, Division 70 of the Los Angeles Municipal Code, which addresses grading, excavation, and fill. Design and construction would also be required to adhere to applicable requirements of the Department of the State Architect and federal building code. Although adherence to these regulations is required for Project implementation, mitigation measures MM-GEO-1 and MM-GEO-2, which require additional geotechnical investigations to be performed once proposed building configurations are finalized to the design level, are included to ensure compliance with building and municipal code requirements pertaining to geological hazards.

Based on the *Geotechnical Investigation* performed by Geocon West, Inc., no soil or geologic conditions were encountered during the geotechnical investigation that would preclude construction of the proposed Project, provided that the recommendations contained in Geocon's report are implemented. However, special design considerations are required for excavation and foundation systems, as indicated in the analysis below.

Soil Conditions

As previously stated, soils on the Project site have the potential to corrode buried metals and other construction materials, which could weaken and degrade underground structures. This is a potentially significant impact.

Laboratory tests were performed on samples of alluvium and bedrock to measure the percentage of water-soluble sulfate content as part of the Preliminary Geotechnical Investigation prepared by Geocon West, Inc. for the proposed Project (included in **Appendix IV.E** of this Draft EIR). Results from the laboratory water-soluble sulfate tests indicate that the on-site materials possess "negligible" sulfate exposure to concrete structures. Therefore, impacts related to sulfate exposure would be less than significant.

Groundwater

The proposed Project would redevelop the lower-lying portions of the Project where groundwater is closest to the surface, as well as construct building foundations and subterranean parking elsewhere on the Project site. Associated excavation and grading activities therefore have the potential to intercept groundwater and saturated soils which is a potentially significant impact.

During Project operation, uncontrolled infiltration of irrigation and storm runoff into on-site soils supporting proposed buildings would adversely affect the performance of soils supporting proposed buildings and structures, since saturation could cause supporting soils to lose internal shear strength and increase in compressibility, adversely impacting building design. Moreover, excess moisture could result in standing water in subterranean structures such as foundations, floor slabs, walls, and construction joints, damaging efflorescence (precipitation of salts from concrete or other materials), and other adverse effects. Operational groundwater impacts are therefore considered potentially significant.

Seismicity

The Project site is not within an identified Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards. Although the Project could be subjected to strong ground shaking in the event of an earthquake, this hazard is common in Southern California. The location of the Project site relative to known active or potentially active faults indicates that it is not exposed to a greater seismic risk than other sites in the vicinity. Moreover, the effects of ground shaking can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practices. The proposed Project would be designed and built in accordance with the CBC, the Los Angeles Uniform Building Code, and applicable federal building codes, which, in general, ensure life safety for occupants in the event of the strong earthquake ground motions expected to occur in the Project site vicinity. Project impacts related to seismicity would therefore be less than significant.

With respect to seismically-induced ground settlement, portions of the Project site are underlain by undocumented fill, topsoil, colluvium, and alluvium to depths as great as 45 feet, which are not considered suitable for direct or permanent support structural loads. The alluvial and colluvial soils are subject to consolidation under static loading and seismically-induced settlement, which could result in excessive differential settlements. Impacts related to seismically-induced ground settlement are therefore potentially significant.

Liquefaction

The lower-lying portions of the Project site adjacent to Stadium Way are underlain by alluvial deposits where groundwater was encountered at depths between nine and 20 feet. Thus, the lower-lying portions of the eastern and western Project sites are subject to liquefaction. However, the proposed Project is required to be designed in accordance with current engineering practices, the CBC, the Los Angeles Uniform Building Code, and applicable federal building codes, which, in general, ensure life safety for occupants in the event of the strong earthquake ground motions expected to occur in the Project site vicinity. Project impacts related to liquefaction would therefore be less than significant.

Slope Stability and Landslides

As stated above, the Project site is not within an area identified by the County or City of Los Angeles as being subject to slope instability.[10] However, portions of the western Project site are identified in the *Geotechnical Investigation* as having the potential for seismic slope instability.

The bedrock underlying the site consists of well-bedded siltstone and sandstone of the Miocene Age Puente Formation. Along the eastern Project site, south-, southwest-, and west-facing excavations for proposed development would expose some components of unfavorable bedding and jointing where bedrock is exposed, and may therefore be unstable.[11] Additionally, potentially exposed unfavorable bedding and jointing on the Project site could induce a potential "surcharge" on structures such as foundations and retaining walls.

Additionally, where alluvium or colluvium is present above a sloping bedrock contact, there is a potential for downhill creep of the alluvium or colluvium. Where "deepened" foundations penetrate through alluvium or colluvium located above a sloping bedrock contact, the portion of the pile penetrating through the creep prone alluvium and colluvium could be subject to lateral loads due to creep forces.

Impacts related to slope stability and landslides are therefore considered potentially significant.

Other Geological Hazards

The potential for other geologic hazards such as peat oxidation, earthquake-induced flooding, and volcanic eruption to adversely affect the proposed Project, or to be adversely affected by the Project, is considered low. Therefore, impacts related to these geologic hazards would be less than significant and no mitigation is required.

ii. Sedimentation and Erosion

GEO-2 Would the Project constitute a geologic hazard to other properties by causing or accelerating instability from erosion?

10 County of Los Angeles, *Technical Appendix to the Safety Element of the Los Angeles County General Plan*, 1990; City of Los Angeles, *Safety Element of the Los Angeles City General Plan*, 1996.

11 Geocon West, Inc., *Update to Preliminary Geotechnical Investigation: Barlow Respiratory Hospital*, April 2010.

GEO-3 Would the Project accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on site?

Construction activity associated with Project site development has the potential to result in wind- and water-driven soil erosion during Project grading activities due to exposure of slopes and/or stockpiled or exposed soils throughout Project construction. Since Project construction would occur for a limited period of time, any such impact would be short-term and temporary. In addition, because of the absence of major drainages within the vicinity of the Project site, large-scale sedimentation is not expected to occur on the Project site. Nevertheless, during Project construction, potentially significant impacts associated with erosion and sedimentation could occur.

iii. Landform Alteration

GEO-4 Would the Project have one or more distinct and prominent geologic or topographic features destroyed, permanently covered, or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hill slopes, canyons, ravines, rock outcrops, water bodies, streambeds, and wetlands?

As discussed previously, while the Project site possesses considerable topographic relief between low-lying portions along Stadium Way and the eastern, western, and northern perimeters of the Project site, there are no unique geologic features present on-site. Therefore, no impacts related to landform alteration would occur.

e. Mitigation Measures

The following mitigation measures, which are based on recommendations contained in the *Geotechnical Investigation* prepared for the proposed Project, are required to reduce impacts to less than significant levels.

i. Additional Future Geotechnical Investigation

MM-GEO-1 Project-level (i.e., building-specific) geotechnical investigations shall be required of the applicant and its contractors prior to finalizing grading, foundation, and construction plans for individual proposed Project buildings and Project site improvements. The engineer's recommendations shall be implemented by the applicant and its contractors.

MM-GEO-2 Individual buildings and improvements shall be designed and constructed in accordance with the requirements outlined in the most current edition of the CBC and the Los Angeles Uniform Building Code, as well as all applicable provisions of Chapter IX, Division 70 of the LAMC, which addresses grading, excavation, and fill, Department of the State Architect requirements, and federal building code requirements.

ii. Geologic Hazards

Corrosive Soils

MM-GEO-3 A corrosion engineer shall be retained to evaluate corrosion test results and recommend the necessary engineering precautions to avoid premature corrosion on buried metal pipes and concrete structures in direct contact with the soils where corrosion sensitive improvements are planned. The engineer's recommendations shall be implemented by the applicant and its contractors.

Grading

MM-GEO-4 A pre-construction conference shall be held at the Project site prior to the beginning of grading operations with the owner, contractor, civil engineer and geotechnical engineer in attendance. Special excavation and soil handling requirements shall be discussed at that time, and these requirements shall be implemented by the applicant and its contractors.

MM-GEO-5 In general, temporary cut slopes composed of bedrock, alluvium/colluvium or properly compacted fill, shall be grossly stable at inclinations of 1:1 (horizontal to vertical), or flatter. Potentially unstable cut slopes exposing siltstone and sandstone beds, cohesionless sands, bedding plane shears, or out-of-slope bedding shall be evaluated during grading operations by the geotechnical engineer.

MM-GEO-6 The proposed foundations and retaining walls shall be designed to carry the surcharge load generated by out-of-slope bedding as necessary. Excavations shall be conducted in a manner that maintains stability and must be observed and approved by a geotechnical engineer. The bedrock exposed in the excavation bottom shall be cut or benched so that fill is placed in horizontal layers. Excavation bottoms shall be observed and approved in writing by a geotechnical engineer prior to the placement of engineered fill. Requirements for temporary excavations are provided below.

MM-GEO-7 Excess earthwork generated shall be hauled off-site or used elsewhere on the Project site.

MM-GEO-8 Earthwork shall be observed, and compacted fill tested by a geotechnical engineer. The existing uncertified fill, colluvial/alluvial soils, and bedrock encountered during exploration is suitable for re-use as an engineered fill upon removal of any oversize material and debris. Rocks larger than six inches in diameter shall not be used in engineered fill and shall be removed or crushed as necessary.

MM-GEO-9 Grading shall commence with the removal of all existing vegetation from the area to be graded. Deleterious debris shall be exported from the site and shall not be mixed with the fill soils. All existing underground improvements planned for removal shall be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described in the *Geotechnical Investigation* contained in **Appendix IV.E**.

MM-GEO-10 Proposed foundations and retaining walls along the existing south-, southwest-, and west-facing slopes of the eastern Project site, and south-facing excavations along the western Project site shall be designed to carry the surcharge load generated by out-of-slope bedding as necessary. Excavations shall be conducted in a manner that maintains stability and shall be observed and approved by a geotechnical engineer. The bedrock exposed in the excavation bottom shall be cut or benched so that fill can be placed in horizontal layers. Excavation bottoms shall be observed and approved by a geotechnical engineer prior to the placement of engineered fill. Recommendations for temporary excavations are provided in the *Geotechnical Investigation* contained in **Appendix IV.E**.

MM-GEO-11 The proposed structures and site retaining walls shall be supported on conventional and/or deep foundations bearing exclusively in competent bedrock. Concrete slabs-on-grade shall bear exclusively in competent bedrock or be designed as a structural slab deriving all support from the foundation system which derives support in competent bedrock.

MM-GEO-12 Where engineered fill is to be placed, grading shall commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris, such as wood, shall be exported from the site and shall not be mixed with fill soils. Asphalt and concrete shall not be mixed with the fill soils unless approved by a geotechnical engineer. All existing underground improvements planned for removal shall be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described in the *Geotechnical Investigation* contained in **Appendix IV.E**.

MM-GEO-13 All fill and backfill soils shall be placed in horizontal loose layers approximately six to eight inches thick, moisture conditioned to two percent above optimum moisture content, and compacted to at least 90 percent relative compaction, as determined by *ASTM Test Method D 1557* (latest edition).

MM-GEO-14 All imported fill shall be observed, tested, and approved by a geotechnical engineer prior to bringing soil to the site. Rocks larger than six inches in diameter shall not be used in the fill. Imported soils used in the building pad area shall have an expansion index and sulfate exposure less than or equivalent to the site soils.

MM-GEO-15 Utility trenches shall be properly backfilled in accordance with the requirements of the *Standard Specifications for Public Works Construction* (latest edition). The pipe shall be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least one foot over the pipe. The remainder of the trench backfill shall be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. Utilities that transition through alluvium/colluvium, fill and bedrock shall be designed with flexible connections that allow for some movement of the pipe without damaging the pipe.

Foundation Design

MM-GEO-16 The proposed structures, retaining walls and related improvements shall be supported exclusively in competent bedrock. A combination or conventional (shallow spread) and deepened (piles or caissons) foundations shall be utilized provided all foundations derive support in competent bedrock.

MM-GEO-17 Pile shafts shall be designed for additional lateral loads where deepened foundations penetrate through creep prone alluvium/colluvium above sloping bedrock as indicated in Section 7.10, Lateral Design, of the *Geotechnical Investigation* contained in **Appendix IV.E**.

MM-GEO-18 Concrete slabs-on-grade shall bear exclusively in competent bedrock or be designed as a structural slab deriving all support from the foundation system bearing in bedrock. Where engineered fill placement is required to create a level subgrade for the placement of the structural concrete slab, the fill shall be considered temporary, for construction purposes, and shall not be relied upon for permanent foundation/slab support since all foundations/slabs should bear exclusively in competent bedrock.

Conventional Foundation Design

MM-GEO-19 Continuous footings shall be designed for an allowable bearing capacity of 4,000 pounds per square foot (psf), and be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the required bearing material.

MM-GEO-20 Isolated spread foundations shall be designed for an allowable bearing capacity of 4,250 psf, and be a minimum of 18 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the required bearing material.

MM-GEO-21 The soil bearing pressure above may be increased by 250 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 7,500 psf.

MM-GEO-22 If depth increases are used for the exterior wall footings, a copy of the final construction plans shall be reviewed by a geotechnical engineer to review recommendations and ensure the final construction plans are properly reviewed and revised if necessary.

MM-GEO-23 The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

MM-GEO-24 Continuous footings shall be reinforced with a minimum of four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. The Project structural engineer shall design reinforcement for spread footings and all associated foundation connections, including grade beams and structural slabs.

MM-GEO-25 The above foundation dimensions and minimum reinforcement requirements are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

MM-GEO-26 The slab and foundation subgrade shall be sprinkled with water as necessary; to maintain a moist condition as would be expected in any concrete placement.

MM-GEO-27 Foundation excavations shall be observed by a geotechnical engineer, prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

Deepened Foundation Design

MM-GEO-28 The proposed structures shall be supported on a deepened foundation system consisting of end-bearing caissons and/or drilled cast-in-place concrete friction piles deriving support in the underlying competent bedrock.

MM-GEO-29 End bearing, drilled, cast-in-place concrete caisson foundations shall be designed for a bearing capacity of 5,000 psf, with a minimum of 24-inches in diameter and a minimum of 36 inches into the competent bedrock. The bearing capacity increase for each additional foot of depth shall be 500 psf. The bearing capacity shall not exceed 7,500 psf for the total of dead and frequently applied live loads. The bearing capacity may be increased by one-third for short duration loading, which includes the effects of wind or seismic forces.

MM-GEO-30 All loose and/or disturbed earth materials shall be cleaned from the bottom of the caisson foundation excavations and approved by a geotechnical engineer prior to placing steel or concrete. If loose earth materials are not completely cleaned from the bottom of the excavation, the end bearing properties of the caisson foundation shall be used in design, and the foundation will rely solely on the skin friction (friction pile).

MM-GEO-31 The design recommendations for drilled, cast-in-place, concrete friction piles are presented in Figures C-1 through C-7 of the *Geotechnical Investigation* contained in **Appendix IV.E**, and represent the allowable friction pile capacities based on penetrations through various depths of unsuitable alluvium/colluvium. The maximum alluvium/colluvium penetration depth is not greater than 50 feet. These capacities shall be considered for preliminary design purposes; however, further pile capacity analyses shall be performed as a part of the design level geotechnical study. Drilled cast-in-place concrete friction piles shall be a minimum of 24 inches in diameter and embedded a minimum of 20 feet into competent bedrock.

MM-GEO-32 All drilled pile excavations shall be continuously observed by a geotechnical engineer to verify required penetration into the required bearing materials. The capacity presented is based on the strength of the bedrock and all components of capacity related to the existing fill have been ignored. The capacity may be increased by one-third for transient loads due to wind or seismic forces.

MM-GEO-33 The compressive and tensile strength of the pile sections shall be checked to verify the structural capacity of the piles. All piles shall be tied in two horizontal directions with grade beams or a structural floor slab, provided it is of adequate thickness and reinforcing. The necessary slab thickness and reinforcing shall be determined by the Project structural engineer.

MM-GEO-34 Where pile groups are required, the piles shall be spaced at least 2.5 diameters on centers. If so spaced, there shall be no reduction in the downward capacity of the piles due to group action.

Deepened Foundation Installation

MM-GEO-35 Seepage is expected during pile excavations. Piles placed below the historic groundwater level shall use a tremie to place the concrete into the bottom of the hole. The tremie shall consist of a water-tight tube having a diameter of not less than six inches with a hopper at the top. The tube shall be equipped with a closing device at the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water mitering the tube and, except when the concrete is being placed, the discharge end shall be entirely sealed at all times. The tremie tube shall be kept full of concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous. The tip of the tremie tube shall always be kept about five feet below the surface of the concrete and definite steps and safeguards shall be taken to insure that the tip of the tremie tube is never raised above the surface of the concrete.

MM-GEO-36 Concrete with a strength of 1,000 pounds per square inch (psi) over the initial job specification shall be used where structural concrete is proposed to intercept soils affected by seepage due to groundwater. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste shall be included. The slump shall be commensurate to any research report for the admixture, provided that it shall also be the minimum for a reasonable consistency for placing when water is present.

MM-GEO-37 Casing shall be required where pile excavations penetrate through soft alluvial/colluvial soils or where groundwater seepage is present. The contractor shall have casing onsite prior to the start of drilling activities. Extreme care shall be employed so that the pile is not pulled apart as the casing is withdrawn. At no time shall the distance between the surface of the concrete and the bottom of the casing be less than five feet. A geotechnical engineer shall continuously observe the drilling and pouring of the casing piles.

MM-GEO-38 Closely spaced piles shall be drilled and filled alternately, with the concrete permitted to set at least eight hours before drilling an adjacent hole. Pile excavations shall be filled with concrete as soon after drilling and inspection as possible; the holes shall not be left open overnight.

Lateral Design

MM-GEO-39 Resistance to lateral loading shall be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.40 shall be with the dead load forces in the competent bedrock.

MM-GEO-40 Passive earth pressure for the sides of foundations and slabs poured against bedrock may be computed as an equivalent fluid having a density of 400 pounds per cubic foot (pcf) with a maximum earth pressure of 4,000 pcf. When combining passive and friction for lateral resistance, the passive component shall be reduced by one-third.

Foundation Settlement

MM-GEO-41 Areas of deep soft alluvial and colluvial soils are poorly consolidated and may be prone to settlement and slope creep. This could result in void space beneath the slabs of bedrock supported structures. It is anticipated that one half inch of settlement could occur in every ten vertical feet of poorly consolidated alluvial/colluvial soil. All utilities that transition through these settlement-prone soils shall be designed with flexible connections in order to mitigate potential settlements without damaging the pipes.

MM-GEO-42 The potential for settlement shall be reevaluated by a geotechnical engineer upon completion of final construction plans.

Concrete Slabs-on-Grade

MM-GEO-43 Where engineered fill is required to create a level pad for the placement of the structural concrete slab, the fill is considered temporary and shall not be relied upon for permanent slab support since all foundations/slabs shall bear exclusively in competent bedrock.

MM-GEO-44 Unless specifically designed by the Project structural engineer, concrete slabs-on-grade shall be a minimum of six inches thick. Minimum reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. The bars shall be positioned vertically near the slab midpoint. Where the slab will be used in lieu of grade beams to tie the foundation piles in two horizontal directions, the appropriate thickness and reinforcing for the slab shall be designed by the Project structural engineer.

MM-GEO-45 Slabs with moisture-sensitive floor coverings or that may be used to store moisture-sensitive materials shall be underlain by a vapor retarder barrier placed near the middle of the sand bedding. The vapor retarder barrier shall be specified by the Project architect or developer based on the type of floor covering that will be installed. The vapor retarder barrier design shall be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06).

MM-GEO-46 For seismic design purposes, a coefficient of friction of 0.40 shall be used between concrete slabs and bedrock without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

MM-GEO-47 Exterior slabs, not subject to traffic loads, shall be at least four inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the subgrade shall be moisture conditioned to at least two percent above optimum moisture content and properly compacted.

Crack control joints shall be spaced at intervals not greater than 10 feet and shall be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints shall extend a minimum depth of one-fourth the slab thickness. Construction joints shall be designed by the Project structural engineer. Exterior improvements shall be further addressed in the design-level geotechnical study.

MM-GEO-48 Crack control joints shall be placed at periodic intervals, in particular, where re-entrant slab corners occur.

Retaining Walls

MM-GEO-49 In the event that retaining walls are significantly higher than 25 feet, a geotechnical consultant shall be contacted for additional recommendations and further analyses shall be performed as a part of the design-level geotechnical study.

MM-GEO-50 Retaining wall foundations shall be designed in accordance with the recommendations provided in Section 7.6, Foundation Design, of the *Geotechnical Investigation* contained in **Appendix IV.E**.

MM-GEO-51 Retaining walls shall be designed using a triangular distribution of pressure (active pressure). Restrained walls[12] shall be designed using a triangular distribution of pressure (at-rest pressure). Active and At-Rest pressures shall be designed in accordance with the recommendations in the table below.

[12] Restrained walls are walls that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall.

Earth Material Retained And Slope Inclination Above Wall	Equivalent Fluid Pressure (Pounds Per Cubic Foot) (Active Pressure)	Equivalent Fluid Pressure (Pounds Per Cubic Foot) (At-Rest Pressure)
Engineered Fill – Level Surface	35	55
Engineered Fill with 2:1 Slope above	43	63
Alluvium or Colluvium – Level Surface	45	65
Stable Bedrock	30	50
Unstable Bedrock	62	80
Source: Geocon West, Inc., Update to Preliminary Geotechnical Investigation*, April 2010.*		

MM-GEO-52 Retaining walls shall be properly drained preventing the buildup of hydrostatic pressure. Retaining walls without drainage shall be designed with an equivalent fluid pressure of 90 pcf, which includes hydrostatic pressures plus buoyant lateral earth pressures.

MM-GEO-53 Retaining walls greater than 12 feet in height shall be designed for an additional seismic lateral force presented in Section 7.15 of the *Geotechnical Investigation* contained in **Appendix IV.E**.

Retaining Wall Drainage

MM-GEO-54 Retaining walls shall be provided with a drainage system extended at least two-thirds the height of the wall. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel shall be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 19 of the *Geotechnical Investigation* contained in **Appendix IV.E**). The clean bottom and subdrain pipe, behind a retaining wall, shall be observed by a geotechnical engineer, prior to placement of gravel or compacting backfill. As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, four-foot wide columns along the entire back face of the wall, at eight feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 20 of the *Geotechnical Investigation* contained in **Appendix IV.E**). These vertical columns of drainage material shall be connected at the bottom of the wall to a one-cubic-foot rock pocket drained by a 4-inch sub drain pipe.

MM-GEO-55 Particular care shall be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. A waterproofing consultant shall be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

Dynamic (Seismic) Lateral Forces

MM-GEO-56 The applicant and its contractors shall implement the dynamic (seismic) later force design recommendations set forth in *Geotechnical Investigation* contained in **Appendix IV.E**.

Elevator Pit Design

MM-GEO-57 The elevator pit slab and retaining wall shall be designed by the Project structural engineer. As a minimum, the slab-on-grade for the elevator pit bottom shall be at least four inches thick and reinforced with No. 3 steel reinforcing bars placed 24 inches on center in both horizontal directions, positioned near the slab midpoint. The elevator pit walls shall be designed utilizing the equivalent fluid pressures presented in Section 7.16 of the *Geotechnical Investigation* contained in **Appendix IV.E**.

The equivalent fluid pressure to be used in design of the non-drained elevator pit retaining walls shall be 90 pounds per cubic foot, which includes hydrostatic pressures plus buoyant lateral earth pressures.

MM-GEO-58 Exterior walls and slab shall be waterproofed to prevent excessive moisture inside of the elevator pit.

Elevator Piston

MM-GEO-59 If a plunger-type elevator piston is installed, a deep drilled excavation shall be required. Casing shall be required where drilled excavations penetrate through soft alluvial/colluvial soils or where groundwater seepage is present. It is anticipated that the diameter of the drilled excavation will not be maintained in the soft soils due to squeezing of the excavation and that casing will be required to maintain the design diameter. Caving is not anticipated in drilled excavations into bedrock. The contractor shall have casing onsite prior to commencement of drilling activities. The drilled excavation shall not be situated immediately adjacent to a newly placed footing or pile.

MM-GEO-60 Drilling and installation of the elevator piston shall be continuously observed by a geotechnical engineer.

MM-GEO-61 The annular space between the piston casing and drilled excavation wall shall be filled with a minimum of 1.5-sack slurry or pea gravel pumped from the bottom up. The use of soil to backfill the annular space is prohibited.

Temporary Excavations

MM-GEO-62 Subterranean levels shall be excavated to 25 feet in vertical height. Due to the adverse bedding and jointing configuration of bedrock, excavations into bedrock shall be sloped or shored in order to provide a stable excavation. All cut slopes shall be observed by a geotechnical engineer during excavation. Where adverse bedding is encountered the bedrock shall be trimmed along the angle of bedding. All cut slopes shall be observed and approved by a geotechnical engineer.

MM-GEO-63 The Project can be completed with sloping measures. Recommendations for shoring shall only be provided if deemed necessary and shall be addressed in the design-level study.

MM-GEO-64 Where sufficient space is available, temporary un-surcharged embankments exposing fill, alluvium/colluvium, and favorable bedrock could be sloped back at a uniform 1:1 slope gradient or flatter. A uniform slope does not have a vertical portion.

MM-GEO-65 Where sloped embankments are used, the top of the slope shall be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction embankments are to be maintained during the rainy season, berms shall be located along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. A geotechnical engineer shall inspect the soils exposed in the cut slopes during excavation so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations shall be stabilized within 30 days of initial excavation.

Surface Drainage

MM-GEO-66 Proper surface drainage is critical to the future performance of the Project. Uncontrolled infiltration of irrigation excess and storm runoff into the supporting soils can adversely affect the performance of the planned improvements. Saturation of supporting soils can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage shall be maintained at all times.

MM-GEO-67 All site drainage shall be collected and transferred to the street in non-erosive drainage devices. Drainage shall not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. Landscape irrigation shall not be located within five feet of the building perimeter footings except when enclosed in protected planters.

MM-GEO-68 Positive site drainage shall be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures. Any building pad and pavement areas shall be fine graded such that water is not allowed to pond.

f. Unavoidable Significant Impacts

No unavoidable significant impacts would occur with respect to geological hazards, sedimentation, erosion, or landform alteration with implementation of the Project design features and mitigation measures identified in this section.

g. Cumulative Impacts

As discussed in **Section III**, *General Description of Environmental Setting,* several related projects are proposed and/or planned within the Project vicinity of the Project site. Implementation of the proposed Project and other projects in the Southern California region would cumulatively increase the number of structures and people exposed to geologic- and seismic-related hazards. As long as design and construction of related projects occurs consistent with proper engineering practices and to the requirements of applicable portions of the LAMC as they apply to each component of the Project, development of the related projects would not contribute to cumulatively significant seismic and regional geologic hazards. Accordingly, the proposed Project, considered together with related projects, would not result in a cumulatively considerable contribution to cumulatively significant geologic hazard impacts.