

D.7 Geology and Soils

This section evaluates the potential for the South Bay Substation Relocation Project (Proposed Project) to impact geological and soil conditions in the project area. Section D.7.1 provides a summary of existing geological and soil conditions and associated geologic and seismic hazards in the project study area. Applicable regulations, plans, and standards are listed in Section D.7.2. Potential impacts and mitigation measures for the Proposed Project are presented in Section D.7.3; and alternatives are described and discussed in Section D.7.4. Mitigation monitoring, compliance, and reporting are discussed in Section D.7.5.

D.7.1 Environmental Setting for the Proposed Project

This section presents a discussion of the regional topography, geology, seismicity, soils, and mineral resources in the project area. Baseline geologic information was collected from published and unpublished geologic, seismic, and geotechnical literature covering the Proposed Project alignment and the surrounding area. Site-specific information was obtained from the Geotechnical Investigation for the proposed San Diego Gas & Electric (SDG&E) Bay Boulevard Substation (GEOCON 2007) and SDG&E's Proponent's Environmental Assessment (PEA) (SDG&E 2010). Review of San Diego Association of Governments (SANDAG) and geologic maps and other relevant documents was also performed.

A portion of the proposed Bay Boulevard Substation site was previously used as a liquefied natural gas (LNG) plant. The LNG plant was abandoned and demolished in 1989, and the property has been vacant since. The property is bounded on the east by the San Diego and Arizona Eastern (SD&AE) railroad tracks and Bay Boulevard, to the south by industrial buildings, to the west by salt evaporation ponds, and to the north by the existing South Bay Power Plant (SBPP) (see Figure B-3, Project Overview Map, and Figures B-3a through B-3c, Project Overview Maps South, Central, and North, respectively).

The former LNG storage tanks were surrounded by earth-fill containment berms. The berms still exist and are approximately 5 to 10 feet in height, 10 to 15 feet along the top in width, with a side slope of approximately 2:1 (horizontal to vertical). The crest elevations of the berms range between approximately 14 and 23 feet above mean sea level (amsl). Except for the berms, the majority of the site is relatively flat with a mild slope generally to the north and west and with surface elevations ranging between 7 and 17 feet amsl. Surface runoff is conveyed to a concrete-lined ditch located in the northwest corner of the property (GEOCON 2007).

Geology

The Proposed Project site is located along the western margin of the Peninsular Ranges geomorphic province of Southern California. This geomorphic province encompasses an area that extends from the Los Angeles Basin and Transverse Ranges south to the tip of Baja California. The geomorphic province is characterized by northwest-trending mountain ranges and valleys separated by subparallel fault zones. In general, the Peninsular Ranges are underlain by Jurassic-age metavolcanic and metasedimentary rocks, and by Cretaceous-age igneous rocks of the Southern California batholith. The westernmost portion of the province in San Diego County generally consists of uplifted Upper Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks (SDG&E 2010).

The project area is primarily underlain by Pleistocene age terrace and marine deposits, which has resulted in a wide range of sand, silt, and clay soils. Much of the bay front is made up of artificial fill used to support development along the San Diego Bay and tidal flat margins. The geologic units anticipated to be encountered during construction of the Proposed Project are summarized in Table D.7-1 as follows:

Table D.7-1
General Descriptions and Characteristics of the Geologic Formations

Symbol	Formation	Age	Description
Qudf	Undocumented Fill	Holocene	Soft to firm sandy clay; and loose to medium sandy silt with scattered gravel, shell fragments, and debris
Qal	Alluvium	Holocene	Soft to hard sandy clay, and loose to medium dense clayey sand
Qbp	Bay Point Formation	Pleistocene	Very stiff to hard clay; silty clay; sandy clay; and medium dense to very dense sandy silt, clayey sand; silty sand; and sand

Source: GEOCON 2007

Soils

The soils in the vicinity of the Proposed Project are mapped as Huerhuero loam (2% to 9% slopes), Huerhuero-urban land complex, and tidal flats. Huerhuero soils consist of moderately well-drained loams with clay subsoils that developed in sandy marine sediments. Huerhuero-urban land complex occurs on marine terraces at elevations ranging from sea level to 400 feet amsl. The topography has been altered by cut-and-fill operations for building construction and no longer exhibits the characteristics of Huerhuero soils. Tidal flats are defined as level areas that are periodically inundated with tidal water. They are essentially denuded of vegetation with higher elevations supporting sparse, salt-tolerant plants. Soil texture in tidal flat areas generally ranges from clay to very fine sand (USDA 1973).

Faulting

Earthquake activity, also known as seismicity, is common throughout the Southern California region. The structural patterns in Southern California are dominated by a major tectonic feature, the San Andreas Fault. The San Andreas Fault, a right-lateral strike-slip fault trending roughly northwest/southeast, is located approximately 80 miles northeast of the study area. The San Andreas Fault Zone delineates the boundary between two global tectonic plates known as the Pacific Plate and North American Plate. The Pacific Plate occupies the area west of the San Andreas Fault. Other active faults in the region include the San Jacinto Fault (50 miles northeast), the Elsinore Fault (45.2 miles northeast), the Coronado Bank Fault Zone (12.8 miles southwest, offshore), and the Rose Canyon Fault Zone, which intersects downtown San Diego approximately 3.3 miles northeast of the Proposed Project site (CGS 2007).

An active fault, as defined by the California Division of Mines and Geology (CDMG), is a fault that has exhibited “surface displacement within Holocene time” (about the last 11,000 years). The State of California has established Alquist-Priolo Special Studies Zone (A-P Zone) along and parallel to traces of active faults for the purpose of prohibiting the location of structures on the traces of such faults (CGS 2007). The Proposed Project is located within an established Alquist-Priolo Earthquake Fault Zone associated with the Rose Canyon Fault; however, the Proposed Project site does not cross any active or potentially active faults (GEOCON 2007).

Table D.7-2 lists several aspects of active faults in the study region, including maximum earthquake magnitude; associated maximum peak site acceleration (g); and Modified Mercalli site intensity (MM), which qualifies earthquake intensities in terms of potential effects on people and structures (see Table D.7-3). Maximum credible peak acceleration values are based on the attenuation relationships of Campbell and Bozorgnia (2003). A maximum credible event is considered the maximum magnitude capable for a fault, given its specific size, configuration, and tectonic framework.

Table D.7-2
Active Faults in the Study Area

Fault Name	Distance from Fault to Project Site (miles)	Maximum Earthquake Magnitude	Peak Site Acceleration (g)
Rose Canyon	3.3	7.2	0.43
Coronado Bank	12.8	7.6	0.26
Newport-Inglewood (offshore)	42.5	7.1	0.06
Elsinore (Julian)	45.2	7.1	0.06
Earthquake Valley	49.1	6.5	0.03

Table D.7-2
Active Faults in the Study Area

Fault Name	Distance from Fault to Project Site (miles)	Maximum Earthquake Magnitude	Peak Site Acceleration (g)
Elsinore (Coyote Mountain)	49.2	6.8	0.04
Elsinore (Temecula)	53.3	6.8	0.04

Source: GEOCON 2007

Table D.7-3
Modified Mercalli Scale of Earthquake Intensities

If most of these effects are observed	Intensity is
Earthquake shaking not felt but people may observe marginal effects of large distance earthquakes without identifying these effects as earthquake caused. Among them: trees, liquids, bodies of water sway slowly, or doors swing slowly.	I
Effect on people: Shaking felt by those at rest, especially if they are indoors, and by those on upper floors.	II
Effect on people: Felt by most people indoors. Some can estimate duration of shaking but many may not recognize shaking of building as caused by an earthquake; the shaking is like that caused by the passing of light trucks.	III
Other effects: Hanging objects swing. Structural effects: Windows or doors rattle. Wooden walls and frames creak.	IV
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers awakened. Other effects: Hanging objects swing. Standing autos rock. Crockery clashes, dishes rattle, or glasses clink. Structural effects: Doors close, open, or swing. Windows rattle.	V
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers awakened. Other effects: Hanging objects swing. Shutters or pictures move. Pendulum clocks stop, start, or change rate. Standing autos rock. Crockery clashes, dishes rattle, or glasses clink. Liquids disturbed, some spilled. Small, unstable objects displaced or upset. Structural effects: Weak plaster and Masonry D* crack. Windows break. Doors close, open, or swing.	VI
Effect on people: Felt by everyone. Many are frightened and run outdoors. People walk unsteadily. Other effects: Small church or school bells ring. Pictures thrown off walls, knickknacks and books off shelves. Dishes or glasses broken. Furniture moved or overturned. Trees, bushes shaken visibly, or heard to rustle. Structural effects: Masonry D* damaged; some cracks in Masonry C*. Weak chimneys break at roof line. Plaster, loose bricks, stones, tiles, cornices, unbraced parapets, and architectural ornaments fall. Concrete irrigation ditches damaged.	VII
Effect on people: Difficult to stand. Shaking noticed by auto drivers. Other effects: Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Furniture broken. Hanging objects quiver. Structural effects: Masonry D* heavily damaged; Masonry C* damaged, partially collapses in some cases; some damage to Masonry B*; none to Masonry A*. Stucco and some masonry walls fall. Chimneys, factory stacks, monuments, towers, elevated tanks twist or fall. Frame houses move on foundation if not bolted down; loose panel walls thrown out. Decayed piling broken off.	VIII

**Table D.7-3
Modified Mercalli Scale of Earthquake Intensities**

If most of these effects are observed	Intensity is
<p>Effect on people: General fright. People thrown to ground.</p> <p>Other effects: Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes. Steering of autos affected. Branches broken from trees.</p> <p>Structural effects: Masonry D* destroyed; Masonry C* heavily damaged, sometimes with complete collapse; Masonry B* is seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames cracked. Reservoirs seriously damaged. Underground pipes broken.</p>	IX
<p>Effect on people: General panic.</p> <p>Other effects: Conspicuous cracks in ground. In areas of soft ground, sand is ejected through holes and piles up into a small cone; in muddy areas, water fountains are formed.</p> <p>Structural effects: Most masonry and frame structures destroyed along with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, and embankments. Railroads bent slightly.</p>	X
<p>Effect on people: General panic.</p> <p>Other effects: Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land.</p> <p>Structural effects: General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.</p>	XI
<p>Effect on people: General panic.</p> <p>Other effects: Same as for Intensity X.</p> <p>Structural effects: Damage nearly total, the ultimate catastrophe.</p> <p>Other effects: Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.</p>	XII

- *Masonry A: Good workmanship and mortar, reinforced, designed to resist lateral forces
- *Masonry B: Good workmanship and mortar, reinforced
- *Masonry C: Good workmanship and mortar, unreinforced
- *Masonry D: Poor workmanship and mortar and weak materials, like adobe.

Potential Geologic and Soil Hazards

Fault Rupture

Fault rupture refers to the physical displacement of surface deposits in direct response to movement along a fault. Ground surface displacement is perhaps the most important single factor to be considered in the seismic design of electric transmission lines and underground cables crossing active faults. Other secondary effects related to fault movement, such as ground shaking, liquefaction, and landslides, are discussed in the following paragraphs.

The Proposed Project site is not located on mapped faults. The proposed Bay Boulevard Substation site is approximately 3.3 miles southeast of the Rose Canyon Fault Zone, approximately 12.8 miles east of the Coronado Bank Fault Zone, and approximately 45 to 49 miles west of the Elsinore Fault Zone. The Rose Canyon Fault Zone is the nearest significant seismic hazard to the project.

The Rose Canyon Fault Zone is composed predominantly of right-lateral, strike-slip faults that extend southeast, bisecting the San Diego metropolitan region. The on-shore portion of the Rose Canyon Fault Zone extends along the northeast flank of Mount Soledad in La Jolla and continues southward along the eastern margins of Mission Bay. Between Mission Bay and San Diego Bay, the zone widens and diverges. Portions of the Rose Canyon Fault Zone in downtown areas of San Diego have been designated by the State of California as an Alquist-Priolo Earthquake Fault Zone. The act does not specifically regulate overhead transmission lines, but it does aid in defining areas where fault rupture is most likely to occur.

Strong Ground Shaking

Table D.7-2 lists active earthquake events and estimated peak ground accelerations that would be experienced by the site for the faults considered most likely to subject the Proposed Project area to ground shaking. The Rose Canyon Fault has been characterized by the State as capable of a magnitude 7.2 earthquake. An earthquake associated with the Rose Canyon Fault Zone could result in a Modified Mercalli intensity of VIII (SDG&E 2010).

Subsidence and Differential Settling

Land subsidence is a loss in surface elevation due to removal of subsurface support on the soil structure. Subsidence is recognized as one of the most diverse forms of ground failure, ranging from small or local collapses to broad regional lowering of the earth's surface. Human activities, including dewatering of peat or organic soils, first-time wetting of moisture-deficient low-density soils (hydrocompaction), subterranean mining, and withdrawal of fluids (groundwater, petroleum, geothermal), are often the principle cause of subsidence. However, natural subsidence also occurs as a result of dissolution in limestone aquifers, natural compaction, crustal deformation, and liquefaction. The local geology at the Proposed Project site indicates that land subsidence resulting from fluid withdrawal or seismic shaking would be considered low (SDG&E 2010).

Differential settling of foundations built on unstable soils, or soils subjected to land subsidence, could cause damage to homes, buildings, and roadways. Differential settling generally occurs in unconsolidated or weakened geologic units, including areas underlain by alluvium, recent shoreline deposits, existing landslides, and highly weathered rock. Differential settling can also result from dewatering or over pumping groundwater supplies. Unconsolidated or weakened geologic units in the Proposed Project area may be subject to differential settlement. These include areas of undocumented fill and alluvium (SDG&E 2010).

Unstable Slopes and Landslides

Slope instability has the potential to undermine foundations and cause distortion and distress to overlying structures. Slope failures include landslides, slumps, mudflows, debris flows, block failures, and rock falls. Gravitational and erosional forces that act continuously upon slopes can cause slope failure. Slope stability is directly related to slope steepness, length, and soil (or rock) type. The Proposed Project area is relatively flat with slopes of less than 2%, and is not likely to experience landslides or other forms of slope failure (SDG&E 2010).

Liquefaction and Lateral Spreading

Liquefaction is a phenomenon in which loose, saturated, granular soil deposits lose shear strength and move as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Structures situated on or above potentially liquefiable soil may experience settling (both total and differential) and loss of foundation support. The factors known to influence liquefaction potential include soil type, particle size, relative density, confining pressure, depth to groundwater, and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose, sandy soils, and some silts. Liquefaction generally occurs in areas of high groundwater (depths of 50 feet or less).

GEOCON's evaluation of the potential for liquefaction showed that the site is not susceptible to liquefaction during a seismic event (GEOCON 2007). Due to the dense and cohesive nature of the underlying soils, the potential for liquefaction occurring at the site is considered low (SDG&E 2010).

Tsunami and Seiche

The Proposed Project is adjacent to the southeast end of San Diego Bay at elevations of approximately 7.7 to 24 feet msl. The site is protected from direct ocean waves; however, the 2004 Multi-Jurisdictional Hazard Mitigation Plan of San Diego County shows that the site is within the zone of tsunami maximum projected run-up (GEOCON 2007). Four historic tsunamis have been recorded in San Diego with wave heights ranging from 1.5 to 4.6 feet.

Groundwater

The Proposed Project site is located within a transitional hydrologic zone of the Otay River watershed between a fluvial-dominated riverine system upstream and a tidally dominated estuarine system downstream. The groundwater levels at the site are expected to fluctuate slightly (less than 1 foot) with the tide in San Diego Bay and the water level in the adjacent salt marsh and wetland (GEOCON 2007). ~~Construction of the Bay Boulevard Substation and~~

~~improvements to the transmission lines running into the substation may be significantly less difficult if performed during the dry season.~~

During field studies, groundwater was encountered in all borings at depths between 5 and 13 feet below the existing grade, corresponding to elevations between 2 and 5 feet msl with an average elevation of 4 feet msl (GEOCON 2007). These groundwater level readings were sampled at the end of drilling operation when the boreholes were maintained open for one to three days. They indicate a relatively stable groundwater condition at the time of the field investigation and are considered more reliable as compared with the estimated data from cone penetration testing (CPT) soundings (GEOCON 2007). Also see Section D.9, Hydrology and Water Quality, for a discussion on groundwater.

D.7.2 Applicable Regulations, Plans, and Standards

Geologic resources and geotechnical hazards are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of City general plans contain policies for the protection of geologic features and avoidance of hazards, but do not specifically address transmission line construction projects. For the proposed underground segment, local grading ordinances establish detailed procedures for underground utility construction, including trench backfill, compaction, and testing. Relevant and potentially relevant statutes, regulations, and policies are discussed as follows.

State

California Environmental Quality Act (CEQA) (California Public Resources Code, Section 21000 et seq.) was adopted in 1970 and applies to most public agency decisions to carry out, authorize, or approve projects that may have adverse environmental impacts. CEQA requires that agencies inform themselves about the environmental effects of their proposed actions, consider all relevant information, provide the public with an opportunity to comment on the environmental issues, and avoid or reduce potential environmental harm whenever feasible. Relevant CEQA sections include those for protection of geologic and mineral resources, protection of soil from erosion, and protection of paleontological resources (certain fossils found in sedimentary rocks).

Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (formerly the Special Studies Zoning Act) (California Public Resources Code, Sections 2621–2630) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. While the act does not specifically regulate gas pipelines, it does help define areas where

fault rupture is most likely to occur. The act groups faults into categories of active, potentially active, and inactive. Historical and Holocene-age faults are considered active, late-Quaternary-age and Quaternary-age faults are considered potentially active, and pre-Quaternary-age faults are considered inactive. These classifications are qualified by the conditions that a fault must be shown to be “sufficiently active” and “well defined” by detailed site-specific geologic explorations in order to determine whether building setbacks should be established.

California Seismic Hazards Mapping Act: Seismic Ground Shaking Hazards

The California Seismic Hazards Mapping Act of 1990 (California Public Resources Code, Sections 2690–2699.6) is designed to protect the public from the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. The act requires site-specific geotechnical investigations to identify the hazard and the formulation of mitigation measures before the permitting of most developments designed for human occupancy. Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (CGS 2008), constitutes the guidelines for evaluating seismic hazards other than surface fault rupture and for recommending mitigation measures, as required by California Public Resources Code, Section 2695(a). Because the project area has yet to be mapped, the provisions related to the California Seismic Hazards Mapping Act would not apply.

Erosion Regulations

State regulations pertaining to the management of erosion/sedimentation as they relate to water quality are described in Section D.9, Hydrology and Water Quality, of this ~~Initial Study/Mitigated Negative Declaration~~ EIR. The primary purpose of these regulations and standards is to protect surface waters from the effects of land development. Among other measures included in such regulations and standards are the requirements to reduce the potential for sedimentation caused by erosion.

California Building Code

The 2001 California Building Code (CBC) is based on the 1997 Uniform Building Code (UBC), which is used widely throughout the United States, when adopted on a state-by-state or district-by-district basis, and has been modified for California conditions with numerous more detailed and/or more stringent regulations. The State of California provides minimum standards for structural design and site development for projects containing buildings for human occupancy through the CBC.

Chapter 16 of the CBC (2001) reduces impacts associated with exposure of people and structures to seismic hazards, and it ensures that structures meet specific minimum seismic safety and

structural design standards. Chapter 33 specifies the requirements to be fulfilled for site work, demolition, and construction, including the protection of adjacent properties from damage caused by such work. The CBC requires a site-specific geotechnical study to address seismic issues and identifies seismic factors that must be considered in structural design. Chapter 33 requires all development intended for human occupancy to adhere to regulations pertaining to grading activities, including drainage and erosion control and treatment of expansive soils.

Local

Chula Vista General Plan

The City of Chula Vista's General Plan, Environmental Element, considers geological hazards to be an important consideration when planning for the community and recommends incorporating proper geotechnical engineering techniques in development projects to reduce the risks associated with geologic hazards to an acceptable level (City of Chula Vista 2005). The General Plan lists the following objectives and policies relevant to geological hazards on the Proposed Project area:

- **Objective E-14** Minimize the risk of injury, loss of life, and property damage associated with geologic hazards.
- **Policy E 14.1** To the maximum extent practicable, protect against injury, loss of life, and major property damage through engineering analyses of potential seismic hazards, appropriate engineering design, and the stringent enforcement of all applicable regulations and standards.
- **Policy E 14.2** Prohibit the subdivision, grading, or development of lands subject to potential geologic hazards in the absence of adequate evidence demonstrating that such development would not be adversely affected by such hazards and would not adversely affect surrounding properties.
- **Policy E 14.3** Require site-specific geotechnical investigations for proposals within areas subject to potential geologic hazards; and ensure implementation of all measures deemed necessary by the City Engineer and/or Building Official to avoid or adequately mitigate such hazards.
- **Policy E 14.4** Promote programs to identify un-reinforced masonry buildings and other buildings and structures that would be at risk during seismic events; and promote strengthening of these buildings and structures, where appropriate.
- **Policy E 14.5** Wherever feasible, land uses, buildings, and other structures determined to be unsafe from geologic hazards shall be discontinued, removed, or relocated.

Grading Ordinances

The City of Chula Vista grading ordinance contains detailed procedures for excavation and grading required during construction.

D.7.3 Environmental Impacts and Mitigation Measures

D.7.3.1 Definition and Use of Significance Criteria

Geologic and soil conditions were evaluated with respect to the impacts the project may have on the local geology, as well as the impact specific geologic hazards may have on the Proposed Project. The significance of these impacts was determined on the basis of CEQA statutes (14 CCR 15000 et seq.), guidelines, and appendices; thresholds of significance developed by local agencies; government codes and ordinances; and requirements stipulated by California Alquist-Priolo statutes. Significance criteria and methods of analysis were also based on standards set or expected by agencies for the evaluation of geologic hazards.

Impacts of the project on the geologic environment would be considered significant if:

- Unique geologic features or geologic features of unusual scientific value (including significant fossils) for study or interpretation would be disturbed or otherwise adversely affected by the proposed new transmission line towers and the associated construction activities
- Known mineral and/or energy resources would be rendered inaccessible by substation and transmission line construction
- Geologic processes, such as landslides or erosion, could be triggered or accelerated by construction or disturbance of landforms
- Substantial alteration of topography would be required or could occur beyond that which would result from natural erosion and deposition.
- Impacts of geologic hazards on the project would also be considered significant if the following conditions existed:
 - High potential for earthquake-induced ground shaking to cause liquefaction, settlement, lateral spreading, and/or surface cracking in project areas and probable attendant damage to transmission lines or other project structures
 - Potential for failure of construction excavations or underground borings due to the presence of loose, saturated sand or soft clay

- Presence of corrosive soils that would damage the underground portions of the transmission line, the transmission line support structures, or foundations at the substation.

D.7.3.2 Applicant Proposed Measures

Table D.7-4 presents the applicant proposed measure (APM) proposed by SDG&E to reduce project impacts related to geology and soils.

Table D.7-4
APMs for Geology and Soils

APM No.	Description
APM-GEO-01	SDG&E would consider the recommendations and findings of the geotechnical investigation prepared by GEOCON Inc. and the contractor's geotechnical engineer in the final design of all Proposed Project components to ensure that the potential for expansive soils and differential settling is compensated for in the final design and construction techniques. SDG&E would comply with all applicable codes and seismic standards. In addition, the Proposed Project would be configured according to the Institute of Electrical and Electronics Engineers 693 "Recommended Practices for Seismic Design of Substations" in order to withstand anticipated ground motion. The final design would be reviewed and approved by a professional engineer registered in the State of California prior to construction.

D.7.3.3 Bay Boulevard Substation

Impact G-1: Ground acceleration/ground shaking that could damage components.

Strong earthquake-induced ground shaking can result in damage to foundations and aboveground structures. According to the California Geological Survey, a maximum-magnitude earthquake is defined as the maximum earthquake that appears capable of occurring under the presently known tectonic framework. The proposed Bay Boulevard Substation site is approximately 3.3 miles southeast of the Rose Canyon Fault Zone. The maximum-magnitude earthquake associated with the Rose Canyon Fault Zone has been estimated at magnitude 7.2. The estimated maximum-magnitude ground acceleration expected at the site was calculated to be approximately 0.43 local acceleration due to gravity (g) using the acceleration-attenuation relationships (GEOCON 2007).

Table D.7-2 presents the earthquake events and estimated site accelerations for the faults considered most likely to subject the site to ground shaking. In the event of a major earthquake on any of the above-referenced faults or other significant faults in the Southern California/northern Baja California area, the site could be subjected to moderate to severe ground shaking. As committed to in APM-GEO-01, which requires that final design incorporate standard engineering practices and recommendations from the geotechnical engineer, the Bay Boulevard Substation will be engineered to withstand strong ground movement and moderate ground

deformation. The Institute of Electrical and Electronics Engineers 693 “Recommended Practices for Seismic Design of Substations” has specific requirements to mitigate substation equipment damage. When these requirements are followed, very little structural damage from horizontal ground accelerations approaching 1.0 g is anticipated (GEOCON 2007).

Implementation of APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to hazards associated with strong seismic ground shaking, will reduce potential impacts associated with ground shaking to less than significant (Class III).

Impact G-2: Ground rupture that could displace surface deposits along faults.

The proposed Bay Boulevard Substation site is approximately 3.3 miles southeast of the Rose Canyon Alquist-Priolo Earthquake Fault Zone, which is the nearest significant seismic hazard to the project. The Proposed Project site is not located within the Alquist-Priolo Earthquake Fault Zone or on a mapped active fault; however, the Rose Canyon Fault Zone is considered a significant seismic hazard to the entire San Diego metropolitan area. Considering the local geological setting of the project area, surface faulting would be considered potentially significant. A fault hazard investigation has been performed within the Proposed Project site to determine the presence or absence of faults within the site limits. APM-GEO-01 will ensure that GEOCON’s 2007 study recommendations, such as foundation setbacks, to reduce the fault rupture hazard are incorporated into final design.

Implementation of APM-GEO-01 will reduce potential impacts from ground rupture at the Proposed Project site to less than significant (Class III).

Impact G-3: Seismically induced ground failures, including liquefaction, lateral spreading, and seismic slope instability.

Liquefaction is not known to have occurred historically in the San Diego area since seismic shaking levels have not been sufficient to trigger liquefaction. Due to the dense and cohesive nature of the underlying soils, the potential for liquefaction occurring at the site is considered low (GEOCON 2007). As a result, impacts would be less than significant (Class III).

GEOCON’s 2007 geotechnical study revealed that the Proposed Project site soils have low expansion potential. However, the Bay Point formation soil may contain clayey horizons, which are potentially expansive. Implementation of APM-GEO-01 will ensure that potential impacts to the substation resulting from soil expansion would be less than significant (Class III).

Impact G-4: Slope instability, including landslides, earth flows, and debris flows.

The Proposed Project is located on flat land that is typically not subject to slope instability. Hazards related to slope instability and landslides are generally associated only with foothill areas and mountain terrain, as well as steep riverbanks and levees. On the Proposed Project site, there are no slopes greater than 2%, with the exception of containment berms, which would be removed during the project. Thus, the potential for landslides, earth flows, and/or debris flows would be considered to be less than significant (Class III).

Impact G-5: Soils that could damage foundations or have high erosion potential.

Construction

The completed Bay Boulevard Substation would occupy approximately 10 acres and would be graded during construction. Grading of the substation site and pole work areas for proposed transmission lines would expose soil to erosion by removing the vegetative cover and compromising the soil structure. Rain and wind may potentially further detach soil particles and transport them off site. Because the Proposed Project would be located on flat land, with no slopes greater than 2%, the erosion potential within the substation boundaries would be considered low during construction and very low once construction is complete.

Implementation of Mitigation Measure HYDRO-1, which includes a stormwater pollution prevention plan (SWPPP), will ensure that soil erosion impacts would be reduced to a less-than-significant level (see Section D.9, Hydrology and Water Quality, for more details regarding the SWPPP). As a result, impacts due to soil erosion or loss of topsoil would be less than significant (Class III).

Operation and Maintenance

Ongoing operation and maintenance activities at the proposed Bay Boulevard Substation would be very similar to those that presently occur at the existing South Bay Substation. Additionally, maintenance vehicles would use a proposed access road for routine operation and maintenance activities at the Bay Boulevard Substation and would use existing paved and dirt access roads currently used by SDG&E to access the transmission lines. Therefore, impacts to soil erosion or topsoil would be less than significant (Class III).

Impact G-6: Differential settling.

Groundwater levels and soil moisture fluctuate naturally during the year in response to patterns of precipitation, evaporation, and transpiration. In coastal zones, groundwater is also influenced by the tide. Groundwater typically moves through pores and cracks in bedrock along a gradient,

or from higher elevations to lower elevations, eventually discharging into streams or other water bodies. However, prolonged pumping of confined groundwater, such as in a well, can result in a collapse sinkhole, ground subsidence, or even reduction of support beneath foundations of buildings. Construction of the proposed South Bay Substation is not anticipated to encounter groundwater, and no prolonged dewatering would be required. As described in Section D.9.3.3 (Hydrology and Water Quality), if groundwater is encountered during substation construction, foundations could be poured without the need to dewater. Dewatering-induced settling is not anticipated, and therefore, damage to nearby structures as a result of settling is not expected to occur. Given this, impacts from differential settling as a result of construction of the substation would be less than significant (Class III).

D.7.3.4 South Bay Substation Dismantling

The South Bay Substation Dismantling component of the project involves removing all aboveground structures from the existing substation yard and does not propose to construct any new aboveground or underground facilities at the South Bay Substation site. Therefore, Impact G-1 (ground shaking that could damage components), Impact G-2 (surface rupture), and Impact G-3 (ground failure) would not apply since there would be no new structures subject to seismic or seismically induced events at the site. Impact G-4 (slope instability) would be less than significant (Class III) since the site is relatively flat and no elevation or gradient changes would occur during or following demolition.

Impact G-5 (high erosion potential) would be less than significant (Class III) since the site currently has low erosion potential due to the flat configuration of the substation and the implementation of stabilization measures (i.e., gravel yard) that are currently in place. Erosion during dismantling resulting from soil transported by vehicles and equipment would not be substantial and would be reduced to a less-than-significant level through implementation of Mitigation Measure HYDRO-1, which requires the use of tracking controls. Post-demolition conditions are not anticipated to substantially change the erosion potential of the site.

Grading and excavation, other than removal of concrete foundations, is not anticipated as part of the South Bay Substation Dismantling component of the project. Therefore, there would be no impact to differential settling (Impact G-6).

D.7.3.5 Transmission Interconnections

Impact G-1: Ground acceleration/ground shaking that could damage components.

As previously discussed in Section D.7.3.3, strong earthquake-induced ground shaking (Impact G-1) can result in damage to foundations and aboveground structures. However, underground

facilities, such as the duct bank for the 230, 138, and 69 kilovolt (kV) cables, are generally not subject to the same direct effects of shaking as aboveground structures because they are confined by overlying soils. APM-GEO-01 will ensure that regulation governed by the CBC are incorporated into the final duct bank design to reduce the hazard risk from ground shaking to less than significant (Class III).

Impact G-2: Ground rupture that could displace surface deposits along faults.

The underground alignment is not located on any known active faults; however, the nearby Rose Canyon Fault Zone is considered a significant seismic hazard to the entire San Diego metropolitan area. As committed to in APM-GEO-01, which requires that final design incorporate standard engineering practices and recommendations from the geotechnical engineer, the transmission interconnections would be engineered to withstand strong ground movement and moderate ground deformation to less than significant (Class III).

Impact G-3: Seismically induced ground failures, including liquefaction, lateral spreading, and seismic slope instability.

Liquefaction is not known to have occurred historically in the San Diego area since seismic shaking levels have not been sufficient to trigger liquefaction. Due to the dense and cohesive nature of the underlying soils, the potential for liquefaction occurring at the site is considered low (GEOCON 2007). As a result, impacts would be less than significant (Class III).

GEOCON's 2007 geotechnical study revealed that the Proposed Project site soils have a low expansion potential. However, the Bay Point formation soil may contain clayey horizons, which are potentially expansive. Implementation of APM-GEO-01 will ensure that potential impacts to the transmission interconnections resulting from soil expansion would be less than significant (Class III).

Impact G-4: Slope instability, including landslides, earth flows, and debris flows.

The underground alignment for the 230, 138, and 69 kV cable would take place primarily within SDG&E's existing right-of-way. The terrain along the route is relatively flat. Therefore, no impacts due to landslides, earth flows, or debris flows would be anticipated.

Impact G-5: Soils that could damage foundations or have high erosion potential.

Grading activities required to establish level work areas and staging areas, as well as trenching activities associated with the underground cable installation, would expose soils to wind and water erosion (Impact G-5: Soils that could damage foundations or have high erosion potential). However, the erosion potential would not be considered high since the slope lengths are short

and much of the area is flat or covered with pavement. HYDRO-1, intended to minimize erosion during construction and operation of the project, is discussed in detail in Section D.9, Hydrology and Water Quality. Implementation of Mitigation Measure HYDRO-1, which includes best management practices to control erosion, would ensure that soil loss is not substantial and impacts are less than significant (Class III).

Impact G-6: Differential settling.

As previously discussed in Section D.7.3.3, differential settling (Impact G-6) or consolidation settlement (the process of elimination of excess pore-water pressure) can occur if there is substantial effective stresses on soil particles as groundwater levels are lowered during dewatering operations. This type of settlement can induce damage on nearby improvements, such as structures, sidewalks, and roadways, and would be considered a significant impact. Construction of the proposed South Bay Substation is not anticipated to encounter groundwater and no prolonged dewatering would be required. As described in Section D.9.3.3 (Hydrology and Water Quality), if groundwater is encountered during substation construction, foundations could be poured without the need to dewater. Dewatering-induced settling is not anticipated, and therefore, damage to nearby structures as a result of settling is not expected to occur. Given this, impacts from differential settling as a result of construction of the substation would be less than significant (Class III).

D.7.4 Project Alternatives

D.7.4.1 Gas Insulated Substation Technology Alternative

Environmental Setting

Section D.7.1 describes the geologic setting for the proposed Bay Boulevard Substation site and surrounding areas. SDG&E's Gas Insulated Substation Technology Alternative would occur in the same geologic area and location as the proposed Bay Boulevard Substation site; therefore, the existing geology and soil conditions would be the same as described in Section D.7.1.

Environmental Impacts and Mitigation Measures

Construction of the proposed Bay Boulevard Substation using gas insulated technology would be similar to the Proposed Project with the exception that the new substation would be designed to use gas insulated technology for the 230/69 kV switchyard. All other project components as described for the Proposed Project would remain the same. Under this alternative, use of gas insulated technology equipment would result in an approximately 4.4-acre footprint within the same location as the Proposed Project. Cement or concrete foundations would be utilized in the

same manner as the Proposed Project, but the actual configuration of equipment would be different. However, since the Gas Insulated Substation Technology Alternative would be subject to the same geological hazards as the Proposed Project and would occur in the same location, Impacts G-1 through G-6, as identified for the Proposed Project, would be less than significant (Class III) with implementation of APM-GEO-01.

Comparison to the Proposed Project

Geologic impacts resulting from SDG&E's Gas Insulated Substation Technology Alternative would be identical to the Proposed Project. Impacts associated with seismic events (Impacts G-1 through G-3), site-specific soil conditions (Impacts G-4 and G-5), and project excavation (Impacts G-6) would be the same for the Gas Insulated Substation Technology Alternative as for the Proposed Project. Therefore, with implementation of the APM described in Section D.7.3.2, all impacts would be reduced to a less-than-significant level (Class III) for both the Gas Insulated Substation Technology Alternative and the Proposed Project.

D.7.4.2 Tank Farm Site Alternative

Environmental Setting

The Tank Farm site is located approximately 250 feet north of the existing South Bay Substation. Because this alternative site is located along the San Diego Bay in the vicinity of the Proposed Project, the overall geologic setting would be the similar to that described in Section D.7.1. There is a potential for liquefaction to occur within the undocumented fill that occurs on the Tank Farm Site Alternative (GEOCON 2008).

The environmental setting for the Air Insulated Substation and Gas Insulated Substation Alternatives at the Tank Farm site would be the same, and therefore, the environmental setting is not further discussed in the following Sections D.7.4.2.1 and D.7.4.2.2.

D.7.4.2.1 Tank Farm Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Because the Tank Farm site is located in the same vicinity as the Proposed Project, geologic impacts would be similar to those as identified in Section D.7.3. APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to geologic hazards such as ground shaking and ground rupture (Impacts G-1 and G-2), would reduce potential geologic impacts to less than significant (Class III).

There is a potential for liquefaction to occur within the layers of undocumented fill that are present at the Tank Farm site (Impact G-3). Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the Tank Farm site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

As with the Proposed Project, this alternative site is located on flat land adjacent to San Diego Bay; therefore, impacts to slope stability, including landslides, earth flow, and debris flows (Impact G-4) as well as erosion potential during construction and operation (Impact G-5), would be less than significant (Class III). As described for the Proposed Project, implementation of Mitigation Measure HYDRO-1, which requires preparation of a SWPPP, would ensure any soil loss would not be substantial.

G-1 Geotechnical Investigations for Liquefaction and Slope Instability. SDG&E shall perform design-level geotechnical investigations to evaluate the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. Appropriate measures could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in underground cables to allow ground deformations without damage to structures. The geotechnical investigations prepared by a certified geologist shall be submitted to the CPUC 60 days prior to construction of proposed structures.

Comparison to the Proposed Project

Geologic impacts resulting from the construction and operation of the Tank Farm Site – Air Insulated Substation Alternative would be similar when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. The potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.2.2 Tank Farm Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new

substation and would be constructed at the Tank Farm site. Geologic and soils impacts resulting from the construction and operation of the Tank Farm Site – Gas Insulated Substation Technology Alternative would be the same as described in Section D.7.4.2.1.

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. The Tank Farm Site – Gas Insulated Substation Alternative would require approximately 6 acres for construction and operation of the substation, whereas the Tank Farm Site – Air Insulated Substation Alternative would require approximately 10 acres. Geologic impacts resulting from the construction and operation of the Tank Farm Site – Gas Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. The potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.3 Existing South Bay Substation Site Alternative

Environmental Setting

Section D.7.1 describes the geologic setting for the existing South Bay Substation site and surrounding areas. The Existing South Bay Substation Site Alternative would occur in the same geologic area and location as the Proposed Bay Project; therefore, the overall geologic conditions would be the same as described in Section D.7.1. There is a potential for liquefaction to occur within the undocumented fill that occurs on the Existing South Bay Substation Alternative site (GEOCON 2008).

D.7.4.3.1 Existing South Bay Substation Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Similar to the Proposed Project, the Air Insulated Substation Alternative would be located within 5 miles of the Rose Canyon Fault Zone, and implementation of APM-GEO-1 would ensure that the substation would be properly engineered to protect against strong ground movement, ground deformation, and ground rupture. Therefore, with implementation of APM –GEO-1, Impacts G-1 and G-2 would be less than significant (Class III). Liquefaction within undocumented fill at the substation site remains a possibility (site-specific testing has not been conducted at the site to determine probability of failure during seismic events), and therefore, Mitigation Measure G-1 would be implemented to ensure that the potential for seismically induced ground failure (Impact G-3) including differential settling (Impact G-6) is reduced to less than significant (Class II) levels. The existing substation site and adjacent 3-acre area is relatively flat and development of

the Air Insulated Substation Alternative is not anticipated to include the construction of manufactured slopes that would be susceptible to landslides, earth flows, and debris flows. Therefore, impacts associated with slope instability (Impact G-4) are considered to be less than significant (Class III). The project site is relatively flat, and implementation of a stormwater pollution prevention plan (SWPPP, Mitigation Measure HYDRO-1) would include measures to minimize the erosion potential of on-site soils. Therefore, with implementation of Mitigation Measure HYDRO-1, Impact G-5 would be less than significant (Class III).

Comparison to the Proposed Project

The geologic and soil impacts resulting from the construction and operation of this alternative would be similar when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Because undocumented fill is located at the existing substation site, the potential for liquefaction and settling (Impact G-3 and G-6) is greater than the Proposed Project.

D.7.4.3.2 Existing South Bay Substation Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation, which would be constructed at the existing South Bay Substation site. Geologic impacts would be as identified for the Proposed Project as described in Section D.7.3 and would be less than significant (Class III) for Impacts G-1, G-2, G-4, and G-5.

GEOCON conducted sampling at the Proposed Bay Project site that determined liquefaction potential was low (GEOCON 2007). However, without site-specific testing completed at the existing South Bay Substation and based on the GEOCON 2008 geotechnical investigation prepared for the Chula Vista Bayfront Master Plan Project, there is a potential for liquefaction to occur within the layers of undocumented fill at the existing South Bay Substation site (Impact G-3). Adverse impacts associated with liquefaction include lateral spreading and settlement differential (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the existing South Bay Substation site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. Geologic and soil impacts resulting from the construction and operation of

the Existing South Bay Substation Site – Gas Insulated Substation Alternative would be similar when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.4 Power Plant Site Alternative

Environmental Setting

The Power Plant site is located immediately north of the Proposed Project substation site. Because this alternative site is located adjacent to the San Diego Bay in the vicinity of the Proposed Project, the overall geologic setting would be similar to that described in Section D.7.1. There is a potential for liquefaction to occur within the undocumented fill that occurs on the Power Plant Site Alternative (GEOCON 2008).

The environmental setting for the Air Insulated Substation and Gas Insulated Substation Alternatives at the Power Plant site would be similar, and therefore, the environmental setting is not further discussed in Sections D.7.4.4.1 and D.7.4.4.2.

D.7.4.4.1 Power Plant Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Because the Power Plant site is located in the same vicinity as the Proposed Project, geologic impacts are expected to be similar to those identified in Section D.7.3. APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to geologic hazards such as ground shaking and ground rupture (Impacts G-1 and G-2), would reduce potential geologic impacts to less than significant (Class III).

Based on the GEOCON 2008 geotechnical investigation prepared for the Chula Vista Bayfront Master Plan Project, there is a potential for liquefaction to occur within the layers of undocumented fill that are found at the Power Plant site (Impact G-3). Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the Power Plant site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

As with the Proposed Project, the Power Plant Site Alternative is located on flat land adjacent to the San Diego Bay; therefore, impacts to slope stability, including landslides, earth flow, and

debris flows (Impact G-4) as well as erosion potential during construction and operation (Impact G-5), would be less than significant (Class III). As described for the Proposed Project, implementation of Mitigation Measure HYDRO-1, which requires preparation of a SWPPP, would ensure any soil loss would not be substantial.

Comparison to the Proposed Project

Geologic impacts resulting from the construction and operation of the Power Plant Site – Air Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.4.2 Power Plant Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation and would be constructed at the Power Plant site. Geologic and soils impacts resulting from the construction and operation of the Power Plant Site – Gas Insulated Substation Technology Alternative would be the same as described in Section D.7.4.4.1.

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. The Power Plant Site – Gas Insulated Substation Alternative would require approximately 6 acres for construction and operation of the substation, whereas the Power Plant Site – Air Insulated Substation Alternative would require approximately 10 acres. Geologic and soil impacts resulting from the construction and operation of the Power Plant Site – Gas Insulated Substation Alternative would be similar when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.5 Broadway and Palomar Site Alternative

Environmental Setting

The Broadway and Palomar site is located approximately 1.2 miles southeast of the existing South Bay Substation; therefore, due to the proximity of this alternative to the Proposed Project, the regional topographic and geologic setting is the same as identified in Section D.7.1. The Broadway and Palomar site is underlain by the Bay Point Formation. The Bay Point Formation is

very stiff to hard clay, silty clay, and sandy clay, as well as medium dense to very dense sandy silt, clayey sand, silty sand, and sand. Further, there is a potential for liquefaction to occur on this site (CPUC 2005).

D.7.4.5.1 Broadway and Palomar Site – Air Insulated Substation Alternative

The 9-acre Broadway and Palomar site is not physically large enough to accommodate the 10-acre Air Insulated Substation Alternative. As such, the Air Insulated Substation Alternative is not technically feasible at this site.

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation and would be constructed at the Broadway and Palomar site. Geologic impacts would be as identified for the Proposed Project as described in Section D.7.3 and would be less than significant (Class III) for Impacts G-1, G-2, G-4, and G-5.

GEOCON conducted sampling at the Proposed Bay Project site that determined liquefaction potential was low (GEOCON 2007). However, without site-specific testing completed at the Broadway and Palomar site, there is a potential for liquefaction (Impact G-3) to occur at this site alternative. Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the Broadway and Palomar site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. Geologic and soil impacts resulting from the construction and operation of the Broadway and Palomar Site – Gas Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.6 Goodrich South Campus Site Alternative

Environmental Setting

The Goodrich South Campus is located approximately 0.8 mile north of the existing South Bay Substation. Because this alternative site is located adjacent to the San Diego Bay in the vicinity

of the Proposed Project, the overall geologic and soils setting would be similar to that described in Section D.7.1. There is a potential for liquefaction to occur within the undocumented fill that occurs on the Goodrich South Campus Site Alternative (GEOCON 2008).

The environmental setting for the Air Insulated Substation and Gas Insulated Substation Alternatives at the Goodrich South Campus site would be similar, and therefore, the environmental setting is not further discussed in Sections D.7.4.6.1 and D.7.4.6.2.

D.7.4.6.1 Goodrich South Campus Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Because the Goodrich South Campus site is located in the same vicinity as the Proposed Project, geologic and soils impacts are expected to be similar to those identified in Section D.7.3. APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to geologic hazards such as ground shaking and surface rupture (Impacts G-1 and G-2), would reduce potential geologic impacts to less than significant (Class III).

GEOCON conducted sampling at the Proposed Project site that determined liquefaction potential was low (GEOCON 2007); however, without site-specific testing and based on the GEOCON 2008 geotechnical investigation prepared for the Chula Vista Bayfront Master Plan Project, there is a potential for liquefaction to occur within the layers of undocumented fill that are found at the Goodrich South Campus site (Impact G-3). Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the Goodrich South Campus site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

As with the Proposed Project, the Goodrich South Campus Site Alternative is located on flat land adjacent to the San Diego Bay; therefore, impacts to slope stability, including landslides, earth flow, and debris flows (Impact G-4) as well as erosion potential during construction and operation (Impact G-5), would be less than significant (Class III). As described for the Proposed Project, implementation of Mitigation Measure HYDRO-1, which requires preparation of a SWPPP, would ensure any soil loss would not be substantial.

Comparison to the Proposed Project

Geological impacts resulting from the construction and operation of the Goodrich South Campus Site – Air Insulated Substation Alternative would be similar when compared to the Proposed

Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.6.2 Goodrich South Campus Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation and would be constructed at the Goodrich South Campus site. Geologic and soils impacts resulting from the construction and operation of the Goodrich South Campus Site – Gas Insulated Substation Alternative would be the same as described in Section D.7.4.6.1.

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. The Goodrich South Campus Site – Gas Insulated Substation Alternative would require approximately 6 acres for construction and operation of the substation, whereas the Goodrich South Campus Site – Air Insulated Substation Alternative would require approximately 10 acres. Geologic and soil impacts resulting from the construction and operation of the Goodrich South Campus Site – Gas Insulated Substation Alternative would be similar when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.7 H Street Yard Site Alternative

Environmental Setting

The H Street Yard site is located immediately north of and adjacent to the Goodrich South Campus discussed in Section D.7.4.6. Because this alternative site is located adjacent to the San Diego Bay in the vicinity of the Proposed Project, the overall geologic and soils setting is similar to that described in Section D.7.1. The H Street Yard site is underlain by Bay Deposits (Qb). The Bay Deposits are characterized by soft, saturated black, silty clay, and clayey silt (bay mud) with interlayered lenses of loose silty sand and sandy silt (GEOCON 2008). There is a potential for liquefaction to occur within the layers of undocumented fill and bay deposits.

The environmental setting for the Air Insulated Substation and Gas Insulated Substation Alternatives at the H Street Yard site would be the same, and therefore, the environmental setting is not further discussed in Sections D.7.4.7.1 and D.7.4.7.2.

D.7.4.7.1 H Street Yard Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Because the H Street Yard site is located in the same vicinity as the Proposed Project, geologic and soils impacts are expected to be the similar as identified in Section D.7.3. APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to geologic hazards such as ground shaking and ground rupture (Impacts G-1 and G-2), would reduce potential geologic impacts to less than significant (Class III).

There is a potential for liquefaction to occur within the layers of bay deposits that are found at the H Street Yard site (Impact G-3) (GEOCON 2008). Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the H Street Yard site. Mitigation Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

As with the Proposed Project, impacts to slope stability, including landslides, earth flow, and debris flows (Impact G-4) as well as erosion potential during construction and operation (Impact G-5), would be less than significant (Class III). As described for the Proposed Project, implementation of Mitigation Measure HYDRO-1, which requires preparation of a SWPPP, would ensure any soil loss would not be substantial.

Comparison to the Proposed Project

Geologic impacts resulting from the construction and operation of the H Street Yard Site – Air Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.7.2 H Street Yard Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation and would be constructed at the H Street Yard site. Geologic and soils impacts resulting from the construction and operation of the H Street Yard Site – Gas Insulated Substation Alternative would be the same as described in Section D.7.4.7.1.

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. The H Street Yard Site – Gas Insulated Substation Alternative would require approximately 6 acres for construction and operation of the substation, whereas the H Street Yard Site – Air Insulated Substation Alternative would require approximately 10 acres. Geologic and soil impacts resulting from the construction and operation of the H Street Yard Site – Gas Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.8 Bayside Site Alternative

Environmental Setting

The Bayside site is located approximately 0.9 mile north of the existing South Bay Substation. Because this alternative site is located adjacent to the San Diego Bay in the vicinity of the Proposed Project, the overall geologic and soils setting would be similar to that described in Section D.7.1. There is a potential for liquefaction to occur within the undocumented fill that occurs on the Bayside Site Alternative (GEOCON 2008).

The environmental setting for the Air Insulated Substation and Gas Insulated Substation Alternatives at the Bayside site would be similar, and therefore, the environmental setting is not further discussed in Sections D.7.4.8.1 and D.7.4.8.2.

D.7.4.8.1 Bayside Site – Air Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Because the Bayside site is located in the same vicinity as the Proposed Project, geologic and soils impacts are expected to be similar to those identified in Section D.7.3. APM-GEO-01, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to geologic hazards such as ground shaking and surface rupture (Impacts G-1 and G-2), would reduce potential geologic impacts to less than significant (Class III).

There is a potential for liquefaction to occur within the layers of undocumented fill that is found at the Bayside site (Impact G-3) (GEOCON 2008). Adverse impacts associated with liquefaction include lateral spreading and settlement (Impact G-6) of the liquefiable layers. Therefore, significant impacts could occur as a result of liquefaction potential at the Bayside site. Mitigation

Measure G-1 would reduce potentially significant impacts associated with seismically induced ground failure and settling potential to less-than-significant levels (Class II).

As with the Proposed Project, the Bayside Site Alternative is located on flat land; therefore, impacts to slope stability, including landslides, earth flow, and debris flows (Impact G-4) as well as erosion potential during construction and operation (Impact G-5), would be less than significant (Class III). As described for the Proposed Project, implementation of Mitigation Measure HYDRO-1, which requires preparation of a SWPPP, would ensure any soil loss would not be substantial.

Comparison to the Proposed Project

Geologic impacts resulting from the construction and operation of the Bayside Site – Air Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.8.2 Bayside Site – Gas Insulated Substation Alternative

Environmental Impacts and Mitigation Measures

Under this alternative, a similar development footprint and layout as identified for the Gas Insulated Substation Technology Alternative in Section D.7.4.1 would be required for the new substation and would be constructed at the Bayside site. Geologic and soils impacts resulting from the construction and operation of the Bayside Site – Gas Insulated Substation Alternative would be the same as described in Section D.7.4.8.1.

Comparison to the Proposed Project

As described in Section D.7.4.1, this alternative would result in a smaller overall footprint than the Proposed Project. The Bayside Site – Gas Insulated Substation Alternative would require approximately 6 acres for construction and operation of the substation, whereas the Bayside Site – Air Insulated Substation Alternative would require approximately 10 acres. Geologic and soil impacts resulting from the construction and operation of the Bayside Site – Gas Insulated Substation Alternative would be the same when compared to the Proposed Project for Impacts G-1, G-2, G-4, and G-5. Under this alternative, the potential for liquefaction and settling is greater than the Proposed Project (Impacts G-3 and G-6).

D.7.4.9 Environmental Impacts of the No Project Alternative

Under the No Project Alternative, none of the facilities associated with the Proposed Project would be constructed, and therefore, none of the impacts identified in this section would occur. Under the No Project Alternative, SDG&E may be required to develop additional transmission upgrades as described in Section C.7 of this EIR. The construction of additional transmission upgrades may have an impact on the local geology and soils as well as be impacted by specific geologic hazards. It is anticipated that potential impacts to geology and soils under the No Project Alternative can be mitigated to less than significant through implementation of mitigation measures similar to those identified for the Proposed Project.

D.7.5 Mitigation Monitoring, Compliance, and Reporting

Table D.7-5 shows the mitigation monitoring, compliance, and reporting program (MMCRP) for geology and soils. The California Public Utilities Commission (CPUC) is responsible for ensuring compliance with the provisions of the monitoring program. The APM that SDG&E has made part of the Proposed Project is listed in the following table.

**Table D.7-5
MMCRP for Geology and Soils**

Impact	MM	APM No.	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
Impact G-1: Ground acceleration/ground shaking that could damage components. Impact G-2: Ground rupture that could displace surface deposits along faults. Impact G-3: Seismically induced ground failures, including liquefaction, lateral spreading, and seismic slope instability.		APM-GEO-01	SDG&E would consider the recommendations and findings of the geotechnical investigation prepared by GEOCON Inc. and the contractor's geotechnical engineer in the final design of all Proposed Project components to ensure that the potential for expansive soils and differential settling is compensated for in the final design and construction techniques. SDG&E would comply with all applicable codes and seismic standards. In addition, the Proposed Project would be configured according to the Institute of Electrical and Electronics Engineers 693 "Recommended Practices for Seismic Design of Substations" in order to withstand anticipated ground motion. The final design would be reviewed and approved by a professional engineer registered in the State of California prior to construction.	SDG&E to implement measure as defined and incorporate recommendation and findings (if necessary) on construction plans. SDG&E to provide copies of the geotechnical evaluation to the CPUC.	CPUC to verify incorporation of recommendations and findings on pre-construction plans (if necessary).	Prior to construction. This measure applies to all components of the Proposed Project.
Impact G-3: Seismically induced ground failures, including liquefaction, lateral spreading, and seismic slope instability.	G-1		Geotechnical Investigations for Liquefaction and Slope Instability. SDG&E shall perform design-level geotechnical investigations to evaluate the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. Appropriate measures could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections,	SDG&E to implement measure as defined and incorporate recommendation and findings (if necessary) on construction plans. SDG&E to provide copies of the geotechnical evaluation to the CPUC.	CPUC to verify incorporation of recommendations and findings on pre-construction plans (if necessary).	Prior to construction. This measure applies to all components of the Proposed Project constructed at Alternative Site locations.

**Table D.7-5
MMCRP for Geology and Soils**

Impact	MM	APM No.	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
			and incorporation of slack in underground cables to allow ground deformations without damage to structures. The geotechnical investigations prepared by a certified geologist shall be submitted to the CPUC 60 days prior to construction of proposed structures.			

D.7.6 References

- 14 CCR 15000–15387 and Appendix A–L. Guidelines for Implementation of the California Environmental Quality Act, as amended.
- California Public Resources Code, Division 2, Geology, Mines, and Mining, Chapter 7.5 Alquist-Priolo Earthquake Fault Zoning, Sections 2621–2630.
<http://www.consrv.ca.gov/cgs/codes/prc/Pages/chap-7-5.aspx>.
- California Public Resources Code. Chapter 7.8; Division 2; Sections 2690–2699.6. California Seismic Hazards Mapping Act of 1990. <http://www.consrv.ca.gov/cgs/codes/prc/Pages/chap-7-8.aspx#2690>.
- California Public Resources Code, Section 21000–21177. California Environmental Quality Act, as amended.
- Campbell, K. W., and Y. Bozorgnia, 2003. “Updated near-source ground motion (attenuation) relations for the horizontal and vertical components of peak ground acceleration and acceleration response spectra,” *Bull. Seism. Soc. Am.* 93, 314–331.
- CBC (California Building Code). 2001. California Code of Regulations, Title 24, Part 2, Volume 1. Based on 1997 Uniform Building Code. California Building Standards Commission. Accessed November 8, 2010. <http://publicecodes.citation.com/st/ca/st/b200v07/index.htm?bu=CA-P-2007-999999>.
- CGS (California Geological Survey). 2007. *Fault-Rupture Hazard Zones in California: Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps*. Interim Revision. Special Publication 42. Sacramento, California: California Department of Conservation, California Geological Survey. Accessed August 17, 2011.
http://www.consrv.ca.gov/CGS/information/publications/database/Publications_index.asp. ~~California Department of Conservation, California Geological Survey, *Fault-Rupture Hazard Zones in California*, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps. Special Publication 42.~~
- CGS. 2008. *Guidelines for Evaluating and Mitigating Seismic Hazards in California*. Special Publication 117. Sacramento, California: California Geological Survey. Revised and re-adopted September 11, 2008. <http://www.conservation.ca.gov/cgs/shzp/webdocs/sp117.pdf>.
- City of Chula Vista. 2005. *City of Chula Vista Vision 2020 General Plan*, Chapter 9, “Environmental Element.” Adopted December 13, 2005.

CPUC (California Public Utilities Commission). 2005. *Draft Environmental Impact Report, SDG&E Otay Mesa Power Purchase Agreement Transmission Project*. Prepared by Dudek. March 2005.

GEOCON (GEOCON Incorporated). 2007. *Geotechnical Investigation of the Bayfront Substation*. Prepared for San Diego Gas & Electric Company, July 20, 2007.

GEOCON. 2008. *Preliminary Geotechnical Investigation of the Chula Vista Bayfront Master Plan EIR*. Prepared for San Diego Unified Port District, San Diego, California, February 1, 2008.

SDG&E (San Diego Gas & Electric). 2010. *Proponent's Environmental Assessment (PEA) for the South Bay Substation Relocation Project*. Prepared by Insignia Environmental. June 2010.

USDA (U.S. Department of Agriculture). 1973. *Soil Survey San Diego Area, California*. ~~U.S. Department of~~ USDA Agriculture Soil Conservation Service and Forest Service, in cooperation with University of California Agricultural Experiment Station, U.S. Department of the Interior, Bureau of Indian Affairs, U.S. Department of the Navy, and U.S. Marine Corps.