4.7  GEOLOGY, SOILS, AND MINERAL RESOURCES

This section evaluates the geology, soils, and mineral resources impacts of the proposed Plan. The information presented was compiled from multiple sources as noted throughout the section. Additional information is also provided in Appendix J.

4.7.1  EXISTING CONDITIONS

GEOLOGY AND SOILS

Geologic Conditions

The San Diego region is underlain by two geomorphic provinces: Peninsular Ranges, and the Colorado Desert, which contains the Salton Trough (CGS 2015). The majority of the region is in the Peninsular Ranges province bounded by the Colorado Desert to the east. Extending east of Julian and Jacumba, the Peninsular Ranges province abruptly ends along a series of faults. To the north, the Peninsular Ranges province continues into the Los Angeles basin area; to the south it makes up the Baja California peninsula.

As the Peninsular Ranges province experienced uplifting and tilting, a series of large faults, such as the Elsinore and San Jacinto, developed along the eastern edge of the province. The area to the east of the faults “dropped” down, creating what is now known as the Salton Trough–Gulf of California depression. The Salton Trough, being lower than the surrounding landscape, became an area of deposition with sediments being carried to the depressed area by drainages of the peninsular ranges. Occasionally, the Salton Trough was inundated with marine waters from the Gulf of California, adding marine deposits to the sediment (Peterson 1977), and has been repeatedly filled by floods from the Colorado River.

The coastal plain province extends from the western edge of the Peninsular Ranges to the coastline. The coastal plain ranges in elevation from sea level to approximately 600 feet above mean sea level. Most of the incorporated cities are located in the coastal plain. The province is composed of dissected, mesa-like terraces that graduate inland into rolling hills. The terrain is underlain by sedimentary rocks composed mainly of sandstone, shale, and conglomerate beds, reflecting the erosion of the Peninsular Ranges to the east. The Peninsular Ranges, also known as the lower California province, includes a group of mountain ranges which stretch from southern California to Mexico’s Baja California peninsula.

Seismic Setting

The earth is divided into three main layers, a hard outer crust, a soft middle layer, and the core; the outer crust is broken into large plates. Earthquakes occur when the plates move and scrape against one another at a fault. Southern California is traversed by generally northwest-to-southeast trending faults, with the San Andres fault being the most widely recognized and largest. Most recorded earthquakes and fault ruptures in Southern California have occurred along faults in the San Andreas system.

The San Andreas fault extends a total of 650 miles from Baja California to the California coast north of San Francisco. It is located to the east of the San Diego region, along the east side of Coachella and Imperial valleys. Since high-magnitude shocks transmit energy over large areas, faults located outside of the San Diego region such as the San Andreas can cause ground shaking inside the region during earthquakes. The nearest inhabited sections of the San Diego region are approximately 30 miles from the San Andreas fault.
The entire San Diego region is located within Seismic Zone 4, the zone with the highest risk of earthquake danger (California Seismic Safety Commission 2005). Known earthquake fault lines and Alquist-Priolo Earthquake fault zones in the San Diego region are shown in Figure 4.7-1.

The San Jacinto fault is the largest of the active faults in San Diego region. The fault extends approximately 125 miles from Imperial Valley to San Bernardino. The Coyote Creek fault and Borrego Mountain faults in the northeastern San Diego region are segments of the San Jacinto fault. Historical activity associated with the San Jacinto fault occurred in 1890, 1899, 1968, and 1979. The quake in 1968 had a recorded magnitude of 6.8 and was centered near Ocotillo Wells.

The Elsinore fault represents a serious earthquake hazard for most of the populated areas of the San Diego region. This fault is approximately 135 miles long and is located about 40 miles from downtown San Diego. This fault can register large earthquakes in the range of magnitude 6.9 to 7.0 on the Richter scale with a recurrence interval of approximately 100 years (City of San Diego 2007).

The Rose Canyon fault zone is an active offshore/onshore fault capable of generating an earthquake of magnitude 6.2 to 7.0 on the Richter scale. The fault zone lies partially offshore as part of the Newport/Inglewood fault zone and parallels the northern coastline of the San Diego region within approximately 2 to 6 miles until coming ashore near La Jolla Shores. The onshore segment trends through Rose Canyon, Old Town San Diego, and appears to die out in San Diego Bay (Abbott 1989). The fault zone is composed of a number of fault segments, including the Rose Canyon, Mount Soledad, and Country Club faults.

The La Nación fault zone and the Sweetwater fault run parallel to the Rose Canyon fault zone approximately 5 miles inland from the bay (City of San Diego 2007). The major offshore fault zones are the San Clemente, San Diego Trough, and Coronado Bank. The San Clemente fault zone, located approximately 40 miles off La Jolla, is the largest offshore fault. Tsunamis are a potential hazard associated with seismic setting and fault zones, and are described in Section 4.10, Hydrology.

Fault Rupture

Fault rupture is defined as the breakage of ground along the surface trace of a fault caused by the intersection of the fault surface area ruptured in an earthquake with the earth’s surface. During earthquakes, the ground can rupture at or below the surface. Ground rupture occurs when two lithospheric plates heave past each other, sending waves of motion across the earth. Earthquakes can cause large vertical and/or horizontal displacement of the ground along the fault. Ground rupture can completely demolish structures by rupturing foundations or by tilting foundation slabs and walls, as well as damage buried and above ground utilities. Drinking water can be lost, and the loss of water lines or water pressure can affect emergency services, including fire fighting ability. Research of historical earthquakes has shown that, although only a few structures have been ripped apart by fault rupture, this hazard can produce severe damage to structures built across active fault lines (County of San Diego 2011).
Figure 4.7-1
Earthquake Fault Zones and Seismic Conditions
April 2015

1 Rose Canyon Fault
2 Coronado
3 Silver Strand
4 Sweetwater
5 La Nacion Fault
6 Elsinore Fault (Segment A)
7 Elsinore Fault (Segment B)
8 Elsinore Fault (Segment C)
9 Earthquake Valley
10 Aguanga Fault
11 San Felipe
12 Hot Springs
13 Agua Tibia Fault
14 Coyote Creek Fault
15 Borrego Mountain Fault
16 Clark Fault
17 San Felipe Hills Fault
18 Santa Rosa Fault

---

4.7 Geology, Soils, and Mineral Resources

**Ground Shaking**

Ground shaking produces the vast majority of damage in an earthquake. Several factors control how ground motion interacts with structures, making the hazard of ground shaking difficult to predict. Seismic waves propagating through the earth’s crust are responsible for the ground vibrations normally felt during an earthquake. Seismic waves can vibrate in any direction, and at different frequencies, depending on the frequency content of the earthquake rupture mechanism and the path and material through which the waves are propagating. The earthquake rupture mechanism is the distance from the earthquake source, or epicenter, to an affected site (County of San Diego 2011). The potential damage to public and private buildings and infrastructure from seismic ground shaking can threaten public safety and result in significant economic loss.

**Slope Failure/Landslides**

Slope failure is the movement of soil and rock material downhill to a lower position. Landslides are the most common naturally occurring type of slope failure in the San Diego region. Block falls, slumps, and block glides are specific types of landslides. The region’s landslides are commonly composite slides, a combination of block glides and slumps. Earthquakes can intensify or activate an unstable slope. Loosely and weakly consolidated soils, steepened slopes caused by either human activities or natural causes, and saturated earth materials create a fragile situation easily affected by an earthquake. Landslides in the San Diego region generally occur in sedimentary rocks such as sandstone, siltstone, mudstone, and claystone. When these fine-grained rocks are exposed to the erosional actions of air and water, they often turn into clay. Seams of saturated clays can be responsible for landslides even on gentle slopes.

Major landslides have occurred within the incorporated cities of the region along coastal bluffs. Previous landslides and landslide-prone sedimentary formations are mostly located in the western portion of the unincorporated County. Landslides have also occurred in the granitic terrain in the eastern portion of the unincorporated County. Reactivations of existing landslides can be triggered by a variety of factors, such as heavy rainfall or irrigation, seismic shaking, and grading (County of San Diego 2011).

The California Department of Conservation (CDC) maps and describes landslide hazards in the region on two map sets containing eight mapped quadrangles each. The scale on the maps is used to designate susceptibility to slope hazards and includes four different levels (CDC 2007):

- **Area 1 – Least Susceptible**: Landslides and other features related to slope instability are non-existent to very rare within this area primarily due to lack of steep slopes.
- **Area 2 – Marginally Susceptible**: Landslides and other slope failures are rare within this area although slope hazards are possible on steeper slopes within the area or along its borders.
- **Area 3 – Generally Susceptible**: This category contains two subareas – Subarea 3-1: Although most slopes within this subarea do not contain landslide deposits, they can be expected to fail, locally, when adversely modified. In Subarea 3-2 slopes are less stable and more susceptible to landslide and slope failure.
- **Area 4 – Most Susceptible**: The area is characterized by unstable slopes and includes all landslides shown on the maps (whether active or not) and slopes where there is evidence of downslope creep of surface materials. These slopes are considered naturally unstable and subject to failure even in the absence of human activity. Subarea 4-1 contains observable unstable slopes underlain by both weak materials and adverse geologic structure. Beach areas exposed to sea waves are not included as beach erosion is not considered a slope hazard. Subarea 4-2 includes definite landslides mapped by the CDC, and nearby unstable areas.
Areas in the region which are mapped as Area 4 include portions of the south eastern Imperial Beach Quadrangle which align with southwest potions of the Otay Mesa Quadrangle. The southern tip of Point Loma, along the eastern side of the peninsula, is also an Area 4 region. Area 4 regions are throughout the La Jolla Quadrangle and the La Mesa Quadrangle, in various parts of the San Diego Metropolitan area, and throughout the Del Mar Quadrangle and the southern part of the Rancho Santa Fe Quadrangle. The Oceanside and San Luis Rey, Jamul Mountains, National City, El Cajon, Poway, Escondido, Encinitas, San Marcos, and Valley Center Quadrangles, while all having Area 4 within their boundaries, have less total Area 4 area and in smaller concentration compared to above quadrangles.

Areas prone to landslides are underlain by the Ardath Shale, Friars, Mission Valley, San Diego, and Otay rock formations. The Ardath Shale Formation extends from Torrey Pines State Park to Mission Bay and is composed of a bentonite-rich clay. The Friars Formation occurs from Mission Valley to Carmel Valley. The formation is composed of expandable clays with properties similar to those of bentonite. The Mission Valley Formation is found from Otay Valley to Rancho Bernardo and is composed of fine to medium grained sandstone with cobble, claystone, and expansive clays (Brown 2015). The San Diego Formation occurs throughout the coastal mesas from Mission Valley southward to the Mexican border. The Otay Formation is found in the southwestern portion of the San Diego region and is composed of slide-resistant sandstone with occasional thin interbedding of bentonite clay (City of San Diego 2008).

**Liquefaction**

Liquefaction is a process by which water-saturated granular soils transform from a solid to a liquid state during strong ground shaking. Primary factors controlling development of liquefaction include intensity and duration of ground accelerations, characteristic of the subsurface soils, in situ stress conditions, and depth of groundwater. Sites underlain by relatively loose sandy soils and saturated deposits of fill combined with a shallow groundwater table, which typically are located in alluvial river valleys/basins and floodplains, are susceptible to liquefaction. Large areas within the region known to be subject to liquefaction are, for the most part, found in the eastern parts of the region; however, smaller liquefaction prone areas are scattered throughout the region, including from the international border up through Coronado and along the coast near San Diego Bay and throughout the Point Loma area (Figure 4.7-2) (County of San Diego 2013).

**Expansive Soil**

Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When they absorb water they increase in volume. The more water they absorb the more their volume increases; for example, an expansion of 10 percent is not uncommon. This change in volume can exert enough force on a building or other structure to cause damage.

Expansive soils will also shrink when they dry out. This shrinkage can remove support from structures and result in damage when structures are not designed to withstand changing soil pressures. Fissures in the soil can also develop. These fissures can facilitate dispersion of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures (Geology.com 2014). Expansive soils occur throughout coastal areas of the San Diego region. Areas with potential to have expansive soils within the region occur predominately in the coastal plains, an area of dissected marine terraces and uplands. They can also be found in valleys and on slopes in the foothills and mountains of the Peninsular Ranges province and, to a lesser extent, in the desert (County of San Diego 2007).
Figure 4.7-2
Potential Liquefaction Areas
April 2015

Source: County of San Diego 2013
Expansive soils primarily consist of clayey soils that have a potential for significant volume changes (shrinking and swelling) with moisture fluctuations. According to the National Geologic Map Database’s Swelling Clays Map of the conterminous United States, coastal San Diego lies in an area described as “part of the unit, generally less than fifty percent, consists of clays of slight to moderate swelling potential.” The remaining areas of the region are typically underlain by soils with little or no clays with swelling potential (Olive et al. 1989).

Erosion and Loss of Topsoil

Erosion is defined as a combination of processes in which the materials of the earth’s surface are loosened, dissolved, or worn away, and transported from one place to another by natural agents. Erosion potential in soils is influenced primarily by loose soil texture and steep slopes. Steep slopes and bluffs resulting from beach side erosion and wave action are found along the coastal cities in the northern part of the region, particularly in and near Del Mar, Solana Beach, and Encinitas. Areas of potential slope failure or high erodibility are potentially hazardous. Loose soils and topsoil can be eroded by water or wind forces, whereas soils with high clay content are generally susceptible only to water erosion. The potential for erosion and loss of topsoil generally increases as a result of human activity, primarily through the development of structures and impervious surfaces and the removal of vegetative cover.

MINERAL RESOURCES

Locally important mineral resources in the San Diego region include construction aggregate materials (sand, gravel, and crushed rock), industrial and chemical mineral materials (limestone, dolomite, and marble), and metallic and rare minerals (precious metals, gemstones, iron and other ferro-alloy metals, copper, lead, zinc, and optical-grade calcite) (County of San Diego 2011).

Mineral Resource Zones

Existing urban development in the western portion of the San Diego region has made mining infeasible in many areas where prime deposits of sand, gravel, and stone are located. State law requires cities and counties to plan for the beneficial management of valuable mineral resources. The State Surface Mining and Reclamation Act of 1975 (SMARA) establishes policies for the conservation, development, and reclamation of mineral lands, and requires all cities and counties to incorporate in their general plans the mapped locations of lands categorized as Mineral Resource Zones (MRZs) as designated by the Division of Mines and Geology (DMG). Mineral resource zones are described in Table 4.7-1.

The locations designated MRZ-2 are areas underlain by mineral deposits where geologic data show that significant measured or indicated resources are present, or areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. In general, the existing MRZ-2 areas in the San Diego region are concentrated along major drainages such as the San Luis Rey River, Otay River, the Tijuana River, the San Diego River, Carroll Canyon, Sweetwater River, and the San Dieguito River. Many of the region’s existing mining operations are located along rivers and water courses. More specifically, MRZ-2 locations exist along SR 76, between I-15 and SR 78, north of SR 52 east of I-805, along I-8, in southern Chula Vista and Otay Mesa, and from Imperial Beach south to the U.S./Mexican border. MRZs are depicted in Figure 4.7-3.
Table 4.7-1
Description of Mineral Zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRZ-1</td>
<td>Areas where adequate geologic information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.</td>
</tr>
<tr>
<td>MRZ-2</td>
<td>2a: Areas underlain by mineral deposits where geologic data show that significant measured or indicated resources are present. As shown on the diagram of the California Mineral Land Classification System, MRZ-2 is divided on the basis of both degree of knowledge and economic factors. Areas classified MRZ-2a contain discovered mineral deposits that are either measured or indicated reserves as determined by such evidence as drilling records, sample analysis, surface exposure, and mine information. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits. 2b: Areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. Areas classified MRZ-2b contain discovered deposits that are either inferred reserves or deposits that are presently sub-economic as determined by limited sample analysis, exposure, and past mining history.</td>
</tr>
<tr>
<td>MRZ-3</td>
<td>3a: Areas containing known mineral deposits that may qualify as mineral resources. MRZ-3a areas are considered to have a moderate potential for the discovery of economic mineral deposits. 3b: Areas containing inferred mineral deposits that may qualify as mineral resources. Land classified MRZ-3b represents areas in geologic settings which appear to be favorable environments for the occurrence of specific mineral deposits.</td>
</tr>
<tr>
<td>MRZ-4</td>
<td>Areas where geologic information does not rule out either the presence or absence of mineral resources. The distinction between the MRZ-1 and MRZ-4 categories is that MRZ-4 classification does not imply that there is little likelihood for the presence of mineral resources, but rather there is a lack of knowledge regarding mineral occurrence.</td>
</tr>
</tbody>
</table>

Source: State Mining and Geology Board (SMGB) 2015.

Mineral resources and extraction operations also exist on Tribal lands. On land governed by the Pala Band of Mission Indians, the Oceanview Mine is an operational gem mine active in the Pala Gem Mining District, and various other mines exist within the district. Several active or inactive mines or quarry sites are located within proximity to tribal land boundaries (BIA 1982). Resource recovery sites are areas where mineral resources could be extracted for use, as designated by local land use plans. Locally important resource recovery sites or areas where important resource recovery sites could potentially be located are designated by the California Geologic Survey (CGS) as MRZ-2.

Aggregate Supply

Aggregate materials include sand, gravel, and crushed stone. Aggregate is a key ingredient in concrete and asphalt and is essential for constructing and maintaining the physical framework of buildings and infrastructure, and compose the most important mineral resource category in the region. Aggregate is used in one form or another for the construction of roads and rails, parking lots, buildings, homes, schools, hospitals, shopping centers, and other essential infrastructure. The highest grade aggregate is used to provide the bulk and strength to Portland Concrete Cement (PCC) and Asphalt Cement (AC). Aggregate supply sources within the San Diego region have dropped from 48 mines in 1980 to 27 mines in 1995. Since then, the number of significant and active mines declined to 16 from 1995 through 2011; this decline will likely continue over the next two decades as mining permits expire and/or resources are depleted (SANDAG 2011). SANDAG, in cooperation with Caltrans District 11, completed the San Diego Region Aggregate Supply Study in January 2011 to examine the supply issues related to aggregate. According to the study, there are 1,159 potential aggregate supply sites in the region. Information contained in the San Diego Region Aggregate Study will be used by planners to help manage the region’s aggregate resources (SANDAG 2011). Figure 4.7-4 shows the locations of potential aggregate supply sites.
Mineral Resource Zones
April 2015

Mineral Resource Zone (MRZ) Classification
- MRZ-1: Resource Not Present
- MRZ-2: Resource Present
- MRZ-3: Resource Potentially Present
- MRZ-4: Inconclusive
- Unclassified

Source: California Geological Survey
Figure 4.7-4
Potential Aggregate Supply Sites
April 2015

- Existing Aggregate Mine (2010)

Mineral Resource Zone (MRZ) Classification
- MRZ-2: Resource Present
- MRZ-3: Resource Potentially Present
- MRZ-4: Inconclusive
- Unclassified

Excludes conserved and developed lands

4.7.2  REGULATORY SETTING

FEDERAL LAWS, REGULATIONS, PLANS, AND POLICIES

Earthquake Hazards Reduction Act

In 1977, Congress passed the Earthquake Hazards Reduction Act (EHRA) (Public Law 95-124) establishing the National Earthquake Hazards Reduction Program as a long-term earthquake risk reduction program for the United States. The program initially focused on research, led by USGS and National Science Foundation (NSF), toward understanding and ultimately predicting earthquakes. The current program activities are focused on four broad areas:

- Developing effective measures to reduce earthquake hazards;
- Promoting the adoption of earthquake hazard reduction activities by federal, state, and local governments; national building standards and model building code organizations; engineers, architects, building owners; and others who play a role in planning and constructing buildings, bridges, structures, and critical infrastructure or “lifelines”;
- Improving the basic understanding of earthquakes and their effects on communities, buildings, structures and lifelines, through interdisciplinary research involving engineering, natural sciences, and social, economic, and decision sciences; and

Disaster Mitigation Act of 2000

Disaster Mitigation Act (DMA) 2000 (Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local, and Indian Tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for state, local, and Indian Tribal entities to closely coordinate mitigation planning and implementation efforts. The requirement for a state mitigation plan is continued as a condition of disaster assistance, adding incentives for increased coordination and integration of mitigation activities at the state level through the establishment of requirements for two different levels of state plans. DMA 2000 also established a new requirement for local mitigation plans and authorized up to 7 percent of HMGP funds available to a state for development of state, local, and Indian Tribal mitigation plans (FEMA 2000).

U.S. Geological Survey Landslide Hazard Program

The USGS created the Landslide Hazard Program (LHP) in fulfillment of the requirements of Public Law 106-113. The primary objective of the LHP is to reduce long-term losses from landslide hazards by improving the understanding of the causes of ground failure and suggesting mitigation strategies. The federal government takes the lead role in funding and conducting this research, whereas the reduction of losses due to geologic hazards is primarily a state and local responsibility.
Indian Mineral Development Act of 1982

The Indian Mineral Development Act (IMDA) (25 U.S.C. Sections 2101–2108) outlines provisions for Minerals Agreement contracts for tribal nations. Subject to the approval of the Secretary of the Bureau of Indian Affairs (BIA) and any limitation or provision contained in its constitution or charter, tribes may enter into any joint venture, operating, production sharing, service, managerial, lease or other agreement providing for the exploration for, or extraction, processing, or other development of, energy and nonenergy mineral resources in which such Indian tribe owns a beneficial or restricted interest, or providing for the sale or other disposition of the production or products of such mineral resources.

STATE LAWS, REGULATIONS, PLANS, AND POLICIES

Alquist-Priolo Earthquake Fault Zoning Act

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (renamed in 1994) is “to regulate development near active faults so as to mitigate the hazard of surface fault rupture.” The State Geologist (Chief of the Division of Mines and Geology) is required to delineate Earthquake Fault Zones (formerly known as “Special Studies Zones”) along known active faults. As defined by the DMG, an active fault is one that has had surface displacement within Holocene time (roughly the last 11,000 years) and/or has an instrumental record of seismic activity. Potentially active faults are those that show evidence of surface displacement during Quaternary time (roughly the last 2 million years), but for which evidence of Holocene movement has not been established. The DMG evaluates faults on an individual basis to determine if a fault will be classified as an Alquist-Priolo Earthquake Fault Zone. In general, faults must meet certain DMG criteria, including seismic activity, historic rupture, and geologic evidence to be zoned as an Earthquake Fault Zone. Cities and counties affected by the zones must regulate certain development within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Typically, structures for human occupancy are not allowed within 50 feet of the trace of an active fault. If a property within a zone is not currently developed, a fault study may be required prior to the subdivision of the property or prior to any structure being permitted on the property.

Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act (SHMA) of 1990 (PRC Section 2690–2699.6) directs the CGS to identify and map areas prone to earthquake hazards of liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the SHMA is to reduce the threat to public safety and to minimize the loss of life and property by identifying and mitigating these seismic hazards. The SHMA was passed by the legislature following the 1989 Loma Prieta earthquake. Staff geologists in the Seismic Hazard Mapping Program gather existing geological, geophysical and geotechnical data from numerous sources to compile the Seismic Hazard Zone Maps. They integrate and interpret these data regionally to evaluate the severity of the seismic hazards and designate Zones of Required Investigation for areas prone to liquefaction and earthquake–induced landslides, and determine whether structural design or modification of the project site is necessary to ensure safer development. Site-specific geotechnical investigations are conducted to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most development designed for human occupancy. Cities and counties are then required to use the Seismic Hazard Zone Maps in their land use planning and building permit processes (CGS 2013).
California Building Code

Chapter 16A, Division IV of the California Building Code (CBC), titled “Structural Design,” states that “The purpose of the earthquake provisions herein is primarily to safeguard against major structural failures or loss of life.” The CBC regulates the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic zoning. Seismic zones are mapped areas that are based on proximity to known active faults and the potential for future earthquakes and intensity of seismic shaking. Seismic zones range from 0 to 4, with areas mapped as Zone 4 being potentially subject to the highest accelerations due to seismic shaking and the shortest recurrence intervals. According to the CBC, the entire San Diego region is within seismic Zone 4.

The CBC also contains (1) specific provisions to classify soils as expansive, (2) exploratory boring procedures, (3) soil boring reporting procedures, and (4) special building foundation and investigation requirements. Section 1613A.1 describes earthquake loads, and states that every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions. Additionally, structures that require special consideration of their response characteristics and environment that are not addressed by this code and for which other regulations provide seismic criteria include vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances and nuclear reactors.

Construction General Permit

The State of California adopted a new Construction General Permit, Order No. 2012-0006-DWQ, amending Order No. 2009-0009-DWQ, effective on July 17, 2012. SWRCB Water Quality Order 2012-0006-DWQ (Construction General Permit) regulates construction site storm water management. Dischargers whose projects disturb 1 or more acres of soil, or whose projects disturb less than 1 acre but are part of a larger common plan of development that in total disturbs 1 or more acres, are required to obtain coverage under the general permit for discharges of storm water associated with construction activity. This requirement includes linear projects that disturb 1 or more acres. Construction activity subject to this permit includes clearing, grading, and disturbances to the ground, such as stockpiling or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

Permit applicants are required to submit a Notice of Intent (NOI) to the SWRCB and to prepare a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP identifies BMPs that must be implemented to reduce construction effects on receiving water quality based on pollutants. The BMPs identified are directed at implementing both sediment and erosion control measures and other measures to control chemical contaminants. The SWPPP shall also include descriptions of the BMPs to reduce pollutants in storm water discharges after all construction phases have been completed at the site (postconstruction BMPs). The SWPPP should contain a site map(s) that shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. Additionally, the SWPPP must contain a visual monitoring program, a chemical monitoring program for "nonvisible" pollutants to be implemented if there is a failure of BMPs, and a sediment monitoring plan if the site discharges directly to a waterbody listed on the 303(d) list for sediment (CalEPA 2014).
If a single construction project traverses more than one RWQCB jurisdiction, a complete NOI package (NOI, site map, and fee) and Notice of Termination (upon completion of each section), must be filed for each RWQCB (CalEPA 2014).

**State Surface Mining and Reclamation Act of 1975**

The State Surface Mining and Reclamation Act of 1975 (SMARA) requires all cities and counties to incorporate in their general plans the mapped designations approved by DMG. These designations include lands categorized as MRZs. MRZ classifications are set forth in guidelines developed by the State Mining and Geology Board (SMGB 2007) and are used to communicate information concerning the existence of mineral resources. Mineral lands are mapped using the California Mineral Land commodities at one time in the area, including aggregate, common clay, and dimensions stone. Priority is given to areas where future mineral resources are likely to be mined during the 50-year period following their classification (SMGB 2007).

Section 2762(d) of SMARA establishes specific lead agency noticing requirements prior to permitting a use that would preclude future extraction of identified mineral resources, defined as either (1) the potential to extract minerals in MRZ-2 lands, or (2) land designated in a lead agency’s general plan as having important minerals to be protected. Prior to permitting a use that would threaten the potential to extract minerals in either of these two areas, the lead agency shall prepare a statement specifying its reasons for permitting the proposed use. The statement is required to be forwarded to the State Geologist and SMGB for review and is required to comply with the public review requirements of CEQA.

**California Coastal Act**

Chapter 3: Coastal Resources Planning and Management Policies, Article 6: Development, Section 30253 of the California Coastal Act, provides for the minimization of adverse impacts, including assuring stability and structural integrity, and neither creating nor contributing significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way requiring the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

**Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems**

On June 19, 2012, the SWRCB adopted Resolution No. 2012-0032, adopting the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy). This Policy establishes a statewide, risk-based, tiered approach for the regulation and management of OWTS installations and replacements and sets the level of performance and protection expected from OWTS.

In accordance with Water Code Section 13290 et seq., the Policy sets standards for OWTS that are constructed or replaced, that are subject to a major repair, that pool or discharge waste to the surface of the ground, and that have affected, or will affect, groundwater or surface water to a degree that makes it unfit for drinking water or other uses, or cause a health or other public nuisance condition. The OWTS Policy also includes minimum operating requirements for OWTS that may include siting, construction, and performance requirements; requirements for OWTS near certain waters listed as impaired under Section 303(d) of the Clean Water Act; requirements authorizing local agency implementation of the requirements; corrective action requirements; minimum monitoring requirements; exemption criteria; requirements for determining when an existing OWTS is subject to major repair; and a conditional waiver of waste discharge requirements.
On April 15, 2015, the San Diego Regional Water Quality Control Board (San Diego RWQCB) adopted a Basin Plan amendment that changed water quality objectives for nitrate in groundwater basins. The Basin Plan Amendment also incorporates the State Water Quality Control Policy for Siting, Designing, Operation, and Maintenance of Onsite Wastewater Treatment Systems and made updates related to implementation of waste discharge requirements and adopted resolutions (Gorham 2015). The Basin Plan Amendment incorporates the OWTS Policy into the Basin Plan, and amends the criteria to be used by the San Diego Water Board and local agencies to regulate OWTS in the San Diego Region (SDRWQCB 2015).

REGIONAL AND LOCAL LAWS, REGULATIONS, PLANS, AND POLICIES

General Plans

To comply with Government Code Section 65302, a general plan must include “A conservation element for the conservation, development, and utilization of natural resources including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources” (GCS 65302 (d)), and “A safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence; liquefaction; and other seismic hazards identified pursuant to Chapter 7.8 (commencing with Section 2690) of Division 2 of the Public Resources Code, and other geologic hazards known to the legislative body... The safety element shall include mapping of known seismic and other geologic hazards.” (GCS 65302 (g)). The incorporated cities and County government within San Diego region contain these elements within their general plans, and most contain additional information on disaster relief and emergency preparedness for geologic and seismic hazards.

Sand, gravel, and crushed rock provide construction aggregate materials and are economically the most important mineral resource in the San Diego region (County of San Diego 2008). The locations of mineral resources, if any, are identified in each general plan, while policies and regulations for extraction activities are addressed in general plans and local codes as shown in Table 4.7-2.

County Septic Tank Regulations

The San Diego RWQCB authorizes the County of San Diego Department of Environmental Health to issue septic system (on-site wastewater treatment system) permits throughout the County. The purpose of regulating the design, installation, and maintenance of septic systems is to prevent public health nuisance conditions caused by failing septic systems. The program's goals are to:

- Ensure that these systems can operate in all weather conditions with minimal maintenance;
- Prevent the contamination of groundwater from improperly designed onsite wastewater treatment systems;
- Prevent the contamination of surface water from improperly designed onsite wastewater treatment systems, and
- Prevent premature failure of onsite wastewater treatment systems.
### Table 4.7-2
Policies or Regulations by Jurisdiction

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Policy or Regulation on Mineral Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad</td>
<td>The City of Carlsbad classifies Open Space for Managed Production of Resources, including major mineral resources. (City of Carlsbad 2014).</td>
</tr>
<tr>
<td>Chula Vista</td>
<td>City of Chula Vista Municipal Code Section 19.69 covers surface mining regulations. The Chula Vista General Plan policies concerning mineral resources include: E 5.1 Ensure that permit applications for proposed mineral resource extraction are consistent with the Chula Vista MSCP Subarea Plan. E 5.2 Consider and minimize impacts from mining operations to existing and future surrounding land uses. E 5.3 Ensure that approved mining reclamation plans fully comply with requirements of the Chula Vista MSCP Subarea Plan; Chula Vista Greenbelt Master Plan; Otay Valley Regional Park Concept Plan; and all other applicable plans regarding the restoration of biological habitats and the creation of trails and parkland (City of Chula Vista 2005).</td>
</tr>
<tr>
<td>Coronado</td>
<td>The City of Coronado recognizes the salt ponds as a valuable resource not only for salt evaporation purposes, but also for providing habitat for birds and marine wildlife; as such, the City supports the continuation of the salt extraction industry (City of Coronado 1996).</td>
</tr>
<tr>
<td>Del Mar</td>
<td>The City of Del Mar Municipal Code Chapter 23.32 contains provisions on excavating and grading permits.</td>
</tr>
<tr>
<td>El Cajon</td>
<td>The City of El Cajon does not have any known mineral resources and does not have any lands designated for mineral resource extraction (Shute 2011).</td>
</tr>
<tr>
<td>Encinitas</td>
<td>The City of Encinitas General Plan contains a policy allowing mineral resource extraction within the Coastal Zone, except in environmentally sensitive areas (City of Encinitas 1995).</td>
</tr>
<tr>
<td>Escondido</td>
<td>The City of Escondido does not have any economically significant mineral resources referenced in the General Plan (City of Escondido 2012).</td>
</tr>
<tr>
<td>Imperial Beach</td>
<td>The City of Imperial Beach does not have any economically significant mineral resources (Foltz 2011).</td>
</tr>
<tr>
<td>La Mesa</td>
<td>The City of La Mesa does not have any policies pertaining to mineral resources (City of La Mesa 2012).</td>
</tr>
<tr>
<td>Lemon Grove</td>
<td>The City of Lemon Grove does not have any policies pertaining to mineral resources (City of Lemon Grove 2006).</td>
</tr>
<tr>
<td>National City</td>
<td>The City of National City’s General Plan contains language on the salt ponds of the San Diego National Wildlife Refuge. The U.S. Fish and Wildlife Service has prepared a Comprehensive Conservation Plan that includes a holistic habitat restoration plan for the existing salt works property (City of National City 2012).</td>
</tr>
<tr>
<td>Oceanside</td>
<td>The City of Oceanside General Plan’s long-range policies include regulating mineral extraction activities to minimize hazards and conflicts with other land uses as well as to preserve and enhance the appearance of the area. The General Plan also details erosion control practices for excavation activities (City of Oceanside 2002).</td>
</tr>
<tr>
<td>Poway</td>
<td>The City of Poway’s General Plan states that the City’s only known valuable mineral resource, as recognized by the California Department Conservation Division of Land Resources Mines and Geology, is construction-quality sand and gravel that is located in the southern area of the city. Currently, one sand and gravel extraction operation is located in Beeler Canyon on the southernmost portion of this area. The City’s General Plan also states that areas designated as Region-Serving Open-Space (areas that are lightly developed with activities or facilities that serve the region as unique or outstanding recreational, safety, or managed production such as agriculture, mineral extraction) should be retained as open space and in some cases increased to serve the region’s expanding needs (City of Poway 1991). Chapter 16.54 of the City of Poway’s Municipal Code contains regulations on surface mining and reclamation.</td>
</tr>
<tr>
<td>City of San Diego</td>
<td>The City of San Diego General Plan includes policies to balance mineral extraction with habitat conservation. These policies include: CE-K.1. Promote the recycling and reclamation of construction materials to provide for the City’s current and future growth and development needs (see also Public Facilities). Policy PF-I.1 and Conservation Element, Policy CE-A.8). CE-K.2. Permit new or expanding mining operations within the Multi-Habitat Planning Area (MHPA) in accordance with MSCP policies and guidelines. CE-K.3. Produce sand and gravel with minimal harm and disturbance to adjacent property and communities. CE-K.4. Plan rehabilitation of depleted mineral areas to facilitate reuse consistent with state requirements, the Surface Mining and Reclamation Act (SMARA), and local planning goals and policies, including the MSCP. CE-K.5. Consider local evaporative salt production for future economic value, open space use, and for important ecological habitat (City of San Diego 2008). Section 141.1004 of the City’s Municipal Code covers regulations pertaining to mining and extractive industries.</td>
</tr>
</tbody>
</table>
### 4.7 Geology, Soils, and Mineral Resources

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Policy or Regulation on Mineral Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Marcos</td>
<td>According to the San Marcos General Plan, the planning area is not a suitable source for construction materials. The San Marcos Planning area has land classified in all four MRZ zones: MRZ-1 areas are located north of State Route 78; MRZ-2 areas include small portions between Double Peak, Mt. Whitney, and Franks Peak; and small portions in the northern Sphere of Influence within Twin Oaks Valley Neighborhood; MRZ-3 areas include the majority of the undeveloped northern and southern areas of the City; MRZ-4 covers the majority of the developed areas. The City does not have active mines or quarries (City of San Marcos 2012). City of San Marcos Zoning Ordinance Chapter 20.460 covers regulations pertaining to surface mining.</td>
</tr>
<tr>
<td>Santee</td>
<td>According to the City of Santee’s General Plan, Santee includes a number of areas containing valuable mineral (primarily sand and gravel) resources. These include areas along the San Diego River, within hilly areas north of Carlton Hills, south of Prospect Avenue between Mesa Road and Fanita Drive, and at the north end of Magnolia Avenue. In view of the potential environmental and flooding problems associated with the mining of these resources, the City needs to carefully review and regulate all sand mining and mineral recovery proposals (City of Santee 2003). The City’s General Plan contains specific policies concerning mineral resources: Policy 5.1 The City shall require that all proposed mining operations are adequately reviewed during the project and environmental review processes to minimize to the greatest degree possible, all identified environmental impacts, especially water quality, habitat preservation and bridge undermining. Policy 6.1: The City shall require the planned reclamation of mined lands following extraction of mineral resources with consideration of the land’s potential for recreational, wildlife habitat, and scenic uses as well as for residential, industrial or commercial development (City of Santee 2003). Title 15, Chapter 15.58, Article VI of the City’s Municipal Code covers regulations pertaining to surface mining and reclamation.</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>Chapter 15.40 of the Solana Beach Municipal Code regulates excavations and grading.</td>
</tr>
<tr>
<td>Vista</td>
<td>The Vista General Plan does not have policies regarding the extraction of mineral resources (City of Vista 2011).</td>
</tr>
<tr>
<td>County of San Diego</td>
<td>San Diego County Zoning Ordinance, Section 2820 et seq., known as the 582 Extractive Use Regulations, are intended to identify and create areas within the County where mining, quarrying, or oil extractive uses are permitted. Typically, the 582 Extractive Use Regulations would be applied to areas of mineral deposits to signify the presence of such deposit and notify adjacent or affected properties of the intention to allow extraction of minerals within the zone. These regulations are used to preserve areas with valuable mineral deposits until extraction can take place. San Diego County Zoning Ordinance, Section 6550 et seq. (Extractive Use Regulations) provide the means for public review and regulation of mineral extraction and associated on-site processing operations. County of San Diego Code of Regulatory Ordinances Section 87.701-87.714 regulates all surface mining operations in the unincorporated area of the County of San Diego as authorized by the San Diego County Zoning Ordinance and SMARA. The objectives of these regulations are: a. The continued mining of minerals will be permitted in a manner which will protect the public health and safety and will provide for the protection and subsequent beneficial use of mined and reclaimed land; and b. The possible adverse effects of surface mining operations on the environment, including air pollution, impedance of groundwater movement, water quality degradation, damage to aquatic or wildlife habitat, flooding, erosion and sedimentation, will be prevented or minimized; and c. The production and conservation of minerals will be encouraged while giving consideration to values relating to recreation, watershed, wildlife, range and forage, and aesthetic enjoyment.</td>
</tr>
<tr>
<td>Tribal Lands</td>
<td>Policies and regulations regarding mineral resource extraction or surface mining are determined by the individual tribe.</td>
</tr>
</tbody>
</table>

Source: Data compiled by AECOM in 2014 and 2015.

### Hazard Mitigation Plans

Many geologic and seismic hazard mitigation measures are listed in local general plans. The San Diego County Multi-jurisdictional Hazard Mitigation Plan (County of San Diego 2010), which was required by the federal Disaster Mitigation Act of 2000. The five main purposes of the plan are to enhance public awareness; create a decision tool for management; promote compliance with state and federal program requirements; enhance local policies for hazard mitigation capabilities; and provide inter-jurisdictional coordination. All cities within the San Diego region participate in this plan, as well as the unincorporated County and the Rancho Santa Fe Fire Protection District.
Grading and Erosion Regulations

Consistent with state law, local jurisdictions contain grading and erosion control regulations in their municipal codes. These regulations establish minimum requirements for grading, including clearing and grubbing of vegetation. These regulations ensure compatibility of graded land development sites with surrounding land forms and land uses; prevent unnecessary and unauthorized grading; and facilitate the planning, design, and construction of development sites to maximize safety and human enjoyment while protecting the surrounding natural environment.

Seismic Standards

Many geologic and seismic hazard goals, policies, and mitigation measures are listed in the safety Elements of local general plans, and aim to minimize injury, loss of life, and damage to property resulting from potential geologic and seismic disasters. For example, the San Diego County General Plan Safety Element contains goals and policies to minimize personal injury and property damage resulting from seismic hazards.

Additionally, the Alquist-Priolo Earthquake Fault Zoning Act, described above, requires that before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults.

4.7.3 SIGNIFICANCE CRITERIA

Appendix G of the CEQA Guidelines ("Appendix G") provides criteria for determining the significance of a project's environmental impacts, in the form of Initial Study checklist questions. Unless otherwise noted, the significance criteria specifically developed for this EIR are based on the checklist questions that address the criteria in Appendix G. In some cases, SANDAG has combined checklist questions, edited their wording, or changed their location in the document in an effort to develop significance criteria that reflect the programmatic level of analysis in this EIR, the unique nature of the proposed Plan's geology, soils, and mineral resources impacts, and the unique characteristics of the proposed Plan and EIR.

Specifically, the separate criterion VI(c) in CEQA Appendix G related to project location on unstable geologic units or soils and the criterion VI(d) related to project location on expansive soils have been combined (GEO-2). Additionally, a criterion for mineral resources, which is addressed separately in Appendix G, is included within this section (MR-1) combining criteria XI(a) and XI(b). For the purposes of this EIR, implementation of the proposed Plan would have a significant geology, soils, or mineral resources impact if it would:

GEO-1 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
- Strong seismic ground shaking;
- Seismic-related ground failure, including liquefaction; and
- Seismically-induced landslides.
GEO-2 Locate projects on a geologic unit or soil that is expansive or 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.

GEO-3 Result in substantial soil erosion or the loss of topsoil.

GEO-4 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, potentially causing adverse groundwater impacts.

MR-1 Result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, or result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan.

4.7.4 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

GEO-1 EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS, INCLUDING THE RISK OF LOSS, INJURY, OR DEATH INVOLVING:

- RUPTURE OF A KNOWN EARTHQUAKE FAULT, AS DELINEATED ON THE MOST RECENT ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING MAP ISSUED BY THE STATE GEOLOGIST FOR THE AREA OR BASED ON OTHER SUBSTANTIAL EVIDENCE OF A KNOWN FAULT;
- STRONG SEISMIC GROUND SHAKING;
- SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION; AND
- SEISMICALLY-INDUCED LANDSLIDES.

ANALYSIS METHODOLOGY

This section acknowledges that the entire San Diego region is subject to strong groundshaking during an earthquake on a fault or fault zone inside or outside of the region. It identifies the location of forecasted regional growth and land use change and planned transportation network improvements in relation to known earthquake faults in the San Diego region, including Alquist-Priolo Earthquake Fault Zones. This section also identifies future land use change and transportation network improvements in relation to areas subject to seismic-related ground failure, including liquefaction, and seismically-induced landslides. This section then assesses the exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving earthquakes and these related seismic hazards as a result of forecasted development and planned transportation network improvements. Specific requirements of existing laws and regulations described in the regulatory setting are then assessed for their ability to avoid or reduce the exposure of people or structures to substantial adverse effects.
Regional Growth and Land Use Change

As shown in Figure 4.7-1, several active fault lines and Alquist-Priolo Earthquake Fault Zones are located in developed areas and areas that are forecasted to develop as a result of regional growth and land use change by 2020. Implementation of the proposed Plan would expose people and structures to adverse effects of seismic activity. Areas that contain or are in proximity to Alquist-Priolo Earthquake Fault Zones include downtown San Diego, Coronado, and communities along I-5 from I-8 to SR 52. Additionally, several earthquake fault lines are located in the western third of the region. New development in these areas may expose additional people and structures to seismic activity. As shown in Figure 4.7-1, some of this projected growth would occur near the earthquake fault zones identified below. Additionally, Figures 2.0-2 and 2.0-3 show anticipated 2020 population and housing density, respectively, and as shown on Figure 4.7-1, population and housing by 2020 occurs near earthquake fault zones.

By 2020, approximately 77 percent of new housing units would occur in the City of San Diego, unincorporated County of San Diego, and City of Chula Vista. The City of San Diego lies within the Rose Canyon Fault Zone. Parts of National City, Coronado, and the unincorporated County are within 6 miles of an active fault, as shown on Figure 4.7-1. Other jurisdictions are not near an active fault zone, as shown on Figure 4.7-1.

Earthquakes within 60 miles of the San Diego region are capable of generating strong ground shaking. This ground shaking could be generated along the San Clemente, San Diego Trough, Coronado Bank, Rose Canyon, Elsinore, San Jacinto, and Sweetwater fault zones. Surface rupture and severe ground shaking could cause catastrophic damage to new development associated with implementation of the proposed Plan, including catastrophic damage to built structures for residential, commercial, and other types of development.

As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in developed areas and areas that are forecasted to develop as a result of regional growth and land use change by 2020. Therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

Earthquakes and related seismic hazards, such as landslides and liquefaction, can lead to indirect effects such as fires. Long-term effects associated with earthquakes include phenomena such as regional subsidence or emergence of landmasses and regional changes in groundwater level (County of San Diego 2007). As a result of forecasted regional growth and land use change, the proposed Plan would increase the risk of loss, injury, or death associated with earthquakes and seismic hazards.

Although new development associated with implementation of the proposed Plan would expose people and structures to the direct and indirect effects of earthquakes, earthquake-resistant designs employed on new structures minimize the impact to public safety from seismic events. Additionally, the Alquist-Priolo Earthquake Fault Zoning Act, described in Section 4.7.2, requires that before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed
buildings will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist and if an active fault is found, a structure for human occupancy cannot be placed over the fault and must be set back, generally 50 feet from the fault. As discussed in Section 4.7.2, Regulatory Setting, there are numerous federal, state, and local laws, regulations, and programs in place to avoid or reduce impacts from earthquakes and other seismic-related geologic hazards, including the location requirements of the Alquist Priolo Earthquake Fault Zoning Act noted above, and adherence to California Building Code, which regulates the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions, and the Seismic Hazards Mapping Act which reduces threats to public safety by identifying and mitigating for seismic hazards. All projects would be required to adhere to design standards described in the CBC and all standard geotechnical investigation, design, grading, and construction practices to avoid or reduce impacts from earthquakes, ground shaking, ground failure, and landslides. Regulatory agencies with oversight of development associated with the proposed Plan have developed regulations and engineering design specifications that address and substantially reduce hazards associated with site-level geological and seismic conditions.

Therefore, regional growth and land use change by 2020 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.

**Transportation Network Improvements**

By 2020, the planned transportation network improvements described in Chapter 2.0 Project Description would be implemented. These improvements would be located in proximity to several fault lines, including the Rose Canyon Fault Line, and Alquist-Priolo Earthquake Fault Zones. Specifically, the Midcoast Trolley extension along the I-5, would be located within three miles of the Rose Canyon Fault Line, and would expose people and structures to risk of loss, injury, or death from earthquakes and other seismic-related geologic hazards. Surface rupture and severe ground shaking could cause catastrophic damage to new transportation network improvements associated with implementation of the proposed Plan. As shown in Figure 2.0-15 and 2.0-18 other various transportation network improvements would be in place by 2020, and as shown on Figure 4.7-1, some of these improvements would be within 9 miles of an earthquake fault line. Due to historical activity of faults in the region, the potential for surface rupture and groundshaking remains.

As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in areas in which transportation network improvements are planned by 2020, therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

As discussed above in Section 4.7.2 and in the regional growth and land use change analysis, existing federal, state, and local laws, regulations, and programs would require each improvement or project to be reviewed by appropriate regulatory agencies prior to construction, and to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from seismic-related geologic hazards.
Therefore, transportation network improvements in place by 2020 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.

2020 Conclusion

Implementation of the proposed Plan regional growth and land use change and transportation network improvements would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. Therefore, this impact (GEO-1) in the year 2020 is less than significant.

2035

Regional Growth and Land Use Change

As discussed in the 2020 analysis above, regional growth and land use change, along with the associated construction of new and redeveloped buildings, would result in significant impacts to the exposure of people and structures to seismic activity, including earthquakes, ground shaking, ground failure, and landslides. This risk would continue to occur into 2035 as development intensities and extension of infrastructure increase to accommodate forecasted growth. As shown in Figure 2.0-12, land use changes by 2035 would result in an increase in regional growth and development, and as shown on Figure 4.7-1, some of this development would occur near an earthquake fault zone. Figures 2.0-5 and 2.0-6 show anticipated 2035 population and housing densities, respectively, and as shown on 4.7-1, population and housing in 2035 occurs near earthquake fault zones.

Approximately 77 percent of the forecasted regional population increase by 2035 is in the City of San Diego (48 percent), County of San Diego (17 percent), and City of Chula Vista (11 percent). Similarly, these three jurisdictions will accommodate approximately 80 percent of new housing units and 68 percent of new jobs, by 2035. As stated in the 2020 analysis, the City of San Diego lies within the Rose Canyon fault zone. The City of Chula Vista lies southwest of earthquake fault lines, shown on Figure 4.7-1, but is not within the nine mile buffer zone.

As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in developed areas and areas that are forecasted to develop as a result of regional growth and land use change by 2035. Implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

By 2035, more people and structures would be susceptible to seismic activity as more development and redevelopment activities would be located in areas in proximity to Alquist-Priolo Earthquake Fault Zones, such as downtown San Diego and nearby coastal communities. As stated in the 2020 analysis, seismic activity can lead to indirect effects such as fires. As discussed in the 2020 analysis, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 and in the 2020 analysis would require new structures to adhere to design standards described in the CBC; therefore, regional growth and land use change by 2035 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.
Transportation Network Improvements

By 2035, additional transportation network improvements described in Chapter 2.0 Project Description would be implemented. As stated in the 2020 analysis, many of the improvements would be located in areas containing Alquist-Priolo Earthquake Fault Zones and other earthquake fault lines, such as the intermodal transit center to be located at San Diego International Airport and associated fault zones shown on Figure 4.7-1. Some of these improvements would also be within 9 miles of an earthquake fault line. Given the location of these improvements, additional people and structures would be at risk of loss, injury, or death from earthquakes and other seismic-related geologic hazards.

As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in developed areas and areas that are forecasted to develop as a result of transportation network improvements by 2035, therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

As discussed above, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 and in the 2020 analysis would require each improvement or project to be reviewed by appropriate regulatory agencies prior to construction, and would require each improvement or project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from seismic-related geologic hazards. Therefore, transportation network improvements in place by 2020 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.

2035 Conclusion

Implementation of the proposed Plan regional growth and land use change and transportation network improvements would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. Therefore, this impact (GEO-1) in the year 2035 is less than significant.

2050

Regional Growth and Land Use Change

As discussed in the 2020 and 2035 analyses above, regional growth and land use change resulting in the construction of new and redeveloped buildings would result in significant impacts to the exposure of people and structures to seismic activity, including earthquakes, ground shaking, ground failure, and landslides. As stated above, seismic activity can also have indirect effects such as fires. This risk would continue to occur into 2050 as development intensities increase and infrastructure is extended to accommodate forecasted growth. As shown in Figure 2.0-13, land use changes by 2050 would result in an increase in regional growth and development, and as shown on Figure 4.7-1, some of this development would occur near an earthquake fault zone. Figures 2.0-8 and 2.0-9 show anticipated 2050 population and housing densities, respectively, and as shown on 4.7-1, population and housing in 2050 occurs near earthquake fault zones. Approximately 75 percent of the forecasted regional population increase by 2050 is in the City of San Diego (49 percent), which lies in the Rose Canyon fault zone.
As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region as shown on Figure 4.7-2, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in developed areas and areas that are forecasted to develop as a result of regional growth and land use change by 2050. Implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

By 2050, the extent of impacts due to seismic activity would increase as additional development and redevelopment activities would be located in areas in proximity to Alquist-Priolo Earthquake Fault Zones, such as downtown San Diego and surrounding coastal communities. As discussed in the 2020 and 2035 analyses, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 would require new structures to adhere to design standards described in the CBC; therefore, regional growth and land use change by 2050 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.

**Transportation Network Improvements**

As shown in Figure 2.0-20 various transportation network improvements would be in place by 2050, and as shown on Figure 4.7-1, some of these improvements would be near an earthquake fault line. As true in the 2020 and 2035 analyses, some of these improvements would be located in areas containing Alquist-Priolo Earthquake Fault Zones and other earthquake fault lines including the Rose Canyon, Coronado, Sweetwater, and La Nacion fault lines. Given the location of these improvements and programs, additional people and structures would be at risk of loss, injury, or death from earthquakes and other seismic-related geologic hazards.

As described above in Section 4.7.1, Area 4 landslide susceptibility zones are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region as shown on Figure 4.7-2, although in denser concentrations in the eastern part of the region. Some of these liquefaction and landslide susceptible areas are located in developed areas and areas that are forecasted to develop as a result of transportation network improvements by 2050, therefore, implementation of the proposed Plan would exposes people and structures to the adverse effects of landslides and liquefaction.

As discussed above, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 would require each improvement or project to be reviewed by appropriate regulatory agencies prior to construction, and would require each improvement or project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce direct and indirect impacts from geologic hazards. Therefore, transportation network improvements in place by 2050 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. This impact is less than significant.

**2050 Conclusion**

Implementation of the proposed Plan regional growth and land use change and transportation network improvements would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction, or seismically-induced landslides. Therefore, this impact (GEO-1) in the year 2050 is less than significant.
GEO-2 LOCATE PROJECTS ON A GEOLOGIC UNIT OR SOIL THAT IS EXPANSIVE OR 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.

ANALYSIS METHODOLOGY

This section identifies the location of forecasted regional growth and land use change and planned transportation network improvements in relation to geologic units and soils that are expansive or unstable, or that would become unstable as a result of land development or a transportation network improvement. The risks associated with locating development projects and transportation network improvements on expansive or unstable geologic units or soils, are described, including on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse. Specific requirements of existing laws and regulations described in the regulatory setting are then assessed for their ability to avoid or reduce these risks. Unstable soils or geologic units resulting in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse because of earthquakes or seismic events are addressed in GEO-1.

2020

Regional Growth and Land Use Change

As stated in Section 2.5 of the project description, from 2012 to 2020, regional population is forecasted to increase by 292,284 people (9 percent), 83,866 housing units (7 percent), and 173,211 jobs (13 percent). Nearly half of the forecasted regional population increase by 2020 is in the City of San Diego. Forecasted regional growth and land use change by 2020 in the coastal areas of the region, including parts of the City of San Diego, would be located on geologic units or soils that are expansive or unstable or that may become unstable as a result of the development. Short-term construction activities such as grading and removal of vegetation in these areas increases the risk that soils would become unstable and result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse. Over the long-term, forecasted development in these areas increases the risk that soils would become unstable and structural damage to regional growth would occur during events like earthquakes or rainstorms.

Lateral spreading is the movement of sloping ground as a result of liquefaction. Areas become more prone to liquefaction and lateral spreading during a large earthquake event. Conditions favorable for lateral spreading are frequently found along streams and waterfronts or in loosely placed, saturated, sandy fill (Rauch 1997). Constructed facilities of most types are vulnerable to heavy damage by lateral spreading, including being pulled apart, buckled, or severe structural damage. In addition, liquefaction can also cause slumping of embankments or tilting of retaining walls that may be associated with regional growth and land use changes. Forecasted regional growth and land use change by 2020 in the coastal areas of the region, shown on Figure 2.0-11, would be located on soils that are prone to lateral spreading and liquefaction.

Subsidence occurs when excessive groundwater pumping causes the compaction of soils, which can then be unstable or cause ground failure. As regional growth and land use changes occur, a growing population by 2020 would demand additional water supply. As stated in Section 4.16.1, the Borrego Valley aquifer has a well documented overdraft condition, and by 2020 is forecast to have an additional 159 housing units over 2012 conditions, which would draw additional groundwater and as a result could cause land subsidence. Groundwater is described in Section 4.16, Water Supply, and Table 4.16-1 lists water supply providers whose source is groundwater. Other impacts associated with groundwater and water supply are described in Section 4.16.
4.7 Geology, Soils, and Mineral Resources

Through adherence to existing laws and regulations, development associated with the proposed Plan would be required to adhere to design standards described in the CBC, including the specific provisions to classify soils as expansive, and all standard design, grading, and construction practices to avoid or reduce geologic hazards, including those associated with unstable geologic units or soils, as described in Section 4.7.2. The incorporated cities and County government within the region have, in their general plans, safety elements required for protections against the risks associated with landslides, subsidence, liquefaction, and other seismic and geologic hazards.

Corrective measures such as structural reinforcement for unstable geologic units and using engineered fill to replace unstable soils would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, ensuring that regional growth and land use changes on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.

Transportation Network Improvements and Programs

By 2020, additional transportation network improvements and programs would be developed, including the Midcoast Trolley extension through the I-5 corridor. Transportation network improvements in place by 2020 are shown on Figures 2.0-15 and 2.0-18, and are summarized in Section 2.5 of the project description. Some of these improvements and programs may involve major grading or earthwork, which increases the likelihood of encountering unstable geologic units or soils. Additionally, some of the transportation network improvements would be located in, on, or near hills, coastal areas, canyons, and other places with steep slopes or unstable soils. These improvements may be at a greater risk associated with unstable geologic units or soils and cause greater risks to people or structures in proximity to these improvements.

As with regional growth and land use changes, the transportation network improvements in place by 2020 that are located in the coastal areas of the region would be subject to lateral spreading and liquefaction, which can cause the slumping of embankments or tilting of retaining walls associated with transportation network improvements. Additionally, liquefaction can cause the failure of highway and railroad embankments built over liquefiable soils (Rauch 1997). Transportation network improvements in areas prone to lateral spreading and liquefaction would be at risk of damage to pavement, misalignment of railroad tracks, or the failure of bridge piers or abutments.

Construction activities associated with transportation network improvements, such as grading and modifying hill slopes, can cause unstable soils. Additionally, the wetting and drying of soils, which is used for dust suppression during construction, and for the maintenance of median landscape irrigation, can cause expansion in soils. Existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 would require each improvement and program to be reviewed by appropriate regulatory agencies prior to construction, and would require each improvement and program to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from unstable geologic units or soils. Adherence to Hazard Mitigation Plans, grading and erosion regulations, and seismic standards including geologic investigations required by the Alquist Priolo Earthquake Fault Zoning Act would reduce geologic hazards.
Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, ensuring that transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- of off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.

**2020 Conclusion**

Project-specific geotechnical investigations consistent with existing regulatory requirements would ensure that regional growth and land use change and transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- of off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, this impact (GEO-2) is less than significant in the year 2020.

**2035**

**Regional Growth and Land Use Change**

As stated in Section 2.5 of the project description, from 2012 to 2035, regional population is forecasted to increase by 710,269 people (23 percent), 228,965 housing units (20 percent), and 319,025 jobs (24 percent). Approximately 48 percent of the forecasted regional population increase by 2035 is in the City of San Diego. These changes are shown on Figure 2.0-12. As discussed in the 2020 analysis, additional regional growth and land use change in the coastal regions, such as parts of the City of San Diego, would result in an increase of the number of structures and facilities that may be in areas with expansive or unstable geologic units or soils, including areas prone to liquefaction, lateral spreading, and subsidence as described in the 2020 analysis. As stated in Section 4.16.1, the Borrego Valley aquifer has a well documented overdraft condition, and by 2035 is forecast to have an additional approximately 550 housing units over 2012 conditions, which would draw additional groundwater and could result in land subsidence.

Impacts would be greater by 2035 than by 2020 as more development or redevelopment activities would occur in coastal communities or near areas with canyons and hills. Development involving unstable geologic units or soils may not be completely avoidable, but site-specific analyses, construction requirements, and operational practices would minimize risks associated with regional growth and land use change.

All projects associated with regional growth and land use change would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce geologic hazards, including those associated with unstable geologic units or soils. Regulatory agencies with oversight on development and land use change associated with the proposed Plan have developed regulations and engineering design specifications to consider and compensate for site-level geological and seismic conditions. The incorporated cities and County government within the region have, in their general plans, safety elements required for protections against the risks associated with landslides, subsidence, liquefaction, and other seismic and geologic hazards. Additionally, Hazard Mitigation Plans, grading and erosion regulations, and seismic standards including geologic investigations required by the Alquist Priolo Earthquake Fault Zoning Act would reduce geologic hazards.
Corrective measures such as structural reinforcement and using engineered fill to replace unstable geologic units or soils would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies. Project-specific geotechnical investigations consistent with existing regulatory requirements that identify areas of damage and recommend geotechnical measures to ensure long-term stability would ensure that regional growth and land use changes on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.

**Transportation Network Improvements and Programs**

As true in the 2020 analysis, transportation network improvements, such as the intermodal transit center to be located at San Diego International Airport and the addition of managed lanes and general purpose lanes, would occur in areas susceptible to unstable geologic units or soils, particularly improvements located in hilly or coastal areas, such as the managed lanes along the I-5. Transportation network improvements and programs are summarized in Section 2.5 of the project description. Specific transportation facilities located in areas prone to unstable geologic units or soils, or where the development of these facilities or programs would be likely to cause slope failure, include coastal projects or expansion of rail and Trolley services through coastal areas or canyons. These improvements may be at a greater risk for effects associated with unstable geologic units, or cause greater risks to people or structures in proximity to these improvements.

As with regional growth and land use changes, the transportation network improvements in place by 2035 that are located in the coastal areas of the region would be subject to lateral spreading and liquefaction, which can cause the slumping of embankments or tilting of retaining walls associated with transportation network improvements. Additionally, liquefaction can cause the failure of highway and railroad embankments built over liquefiable soils (Rauch 1997). Transportation network improvements in areas prone to lateral spreading and liquefaction would be at risk of damage to pavement, misalignment of railroad tracks, or the failure of bridge piers or abutments. The locations of transportation network improvements anticipated by 2035 are shown on Figures 2.0-16 and 2.0-19, and summarized in Section 2.5 of the project description.

Construction activities associated with transportation network improvements, such as grading and modifying hill slopes, can cause unstable soils. Additionally, the wetting and drying of soils, which is used for dust suppression during construction, and for the maintenance of median landscape irrigation, can cause expansion in soils. As discussed above, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 would require each improvement or program to be reviewed by appropriate regulatory agencies prior to construction, and would require each program or improvement to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from unstable geologic units or soils. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, ensuring that transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.
2035 Conclusion

Project-specific geotechnical investigations consistent with existing regulatory requirements would ensure that regional growth and land use change and transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, this impact (GEO-2) is less than significant in the year 2035.

2050

Regional Growth and Land Use Change

As discussed in the 2020 and 2035 analyses above, additional regional growth and land use change would result in an increase of the number of structures and facilities that may be in areas with expansive or unstable geologic units or soils, including areas prone to liquefaction, lateral spreading, and subsidence. As stated in Section 4.16.1, the Borrego Valley aquifer has a well documented overdraft condition, and by 2050 is forecast to have an additional approximately 1,550 housing units over 2012 conditions, which would draw groundwater and could result in land subsidence. Unstable geologic units or soils may not be completely avoidable, but site-specific analyses would minimize risks associated with regional growth and land use change. All projects associated with regional growth and land use change would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce geologic hazards, including those associated with unstable geologic units or soils. Regulatory agencies with oversight on development and land use change associated with the proposed Plan have developed regulations and engineering design specifications to consider and compensate for site-level geological and seismic conditions. The incorporated cities and County government within the region have, in their general plans, safety elements required for protections against the risks associated with landslides, subsidence, liquefaction, and other seismic and geologic hazards. Adherence to Hazard Mitigation Plans, grading and erosion regulations, and seismic standards including geologic investigations required by the Alquist Priolo Earthquake Fault Zoning Act would reduce geologic hazards.

Corrective measures such as structural reinforcement for unstable geologic units and using engineered fill to replace unstable soils would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, ensuring that regional growth and land use changes on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.

Transportation Network Improvements and Programs

Transportation network improvements by 2050 are shown on Figures 2.0-17, 2.0-20, and 2.0-21, and programs are summarized in Section 2.5 of the project description. As true in the 2020 and 2035 analyses, transportation network improvements would occur in areas susceptible to unstable geologic units or soils, particularly improvements located in hilly or coastal areas such as the branch extension of the SPRINTER to Westfield North County, four new trolley extensions, and the Mission Beach to La Jolla streetcar improvements. These improvements may be at a greater risk for effects associated with unstable geologic units or soils, or cause greater risks to people or structures in proximity to these improvements. Specific transportation facilities prone to risks of unstable geologic units or soils, or the development of which would be likely to cause unstable geologic units, include improvements near the coast, and improvements to highways that would involve grading.
As discussed above, existing federal, state, and local laws, regulations, and programs included in Section 4.7.2 would require each improvement or program to be reviewed by appropriate regulatory agencies prior to construction, and would require each improvement or program to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from unstable geologic units or soils. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, ensuring that transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. This impact is less than significant.

2050 Conclusion

Project-specific geotechnical investigations consistent with existing regulatory requirements would ensure that regional growth and land use change and transportation network improvements on geologic units or soils that are expansive or unstable would not become unstable as a result of the project, or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, this impact (GEO-2) is less than significant in the year 2050.

GEO-3 RESULT IN SUBSTANTIAL SOIL EROSION OR THE LOSS OF TOPSOIL.

ANALYSIS METHODOLOGY

Some projects would require extensive cut and fill grading and could result in manufactured slopes that become unstable over time and increase long-term erosion potential. Unusually high volumes of storm water runoff can also cause slope failures, particularly in areas where native soils have a moderate to high erosion potential.

In addition to soil erosion from long-term exposure to water, the analysis also describes the routine soil erosion and loss of topsoil that may also occur as a result of construction activities (movement of bare dirt). Soil is a dynamic natural body capable of supporting a vegetative cover (UMich 2010). Soil is layered into sections called "horizons." The top horizon, or topsoil, is composed of humus and contains organic matter. This layer is often the darkest and consists of particles of decayed leaves, twigs, and animal remains. The minerals in the topsoil are mostly clays and other insoluble minerals. The loss of topsoil can be attributed to a number of factors tied to human development, including deforestation, overexploitation for fuelwood, overgrazing, agricultural activities, and industrialization (UMich 2010). Erosion or loss of topsoil can cause loss of arable land, clogged and polluted waterways, and increased flooding. When topsoil is mobilized, or moved, it is put into the hydrological system as silt and eventually washes out to sea. Erosion is the term given to soil loss due to the mobilization of topsoil by the forces of water and wind. Wind and water move the eroded particles to some other location, where it is deposited as sediment (UMich 2010). The rate of this process, as stated, is highly dependent on human activity. Natural rates of soil erosion are lower for soil with a good cover of vegetation than for bare soil. In addition to the list above, human actions that uncover soil include farming, logging, building, overgrazing, off-road vehicles, fires, etc., and greatly enhance soil erosion rates. Erosion and loss of topsoil are qualitatively discussed in the analysis.

As described in Section 4.10 Hydrology and Water Quality, local regulations and standards for the design and practice of grading, clearing, and filling of land to ensure future land use and transportation projects are in compliance with applicable state and federal laws related to construction and operation are discussed.
During the timeframe of the proposed Plan, climate change effects that are likely to exacerbate the proposed Plan’s soil erosion and loss of topsoil impacts include but are not limited to sea level rise and associated increase in frequency and severity of coastal flooding, less frequent and more intense rainstorms, higher annual average temperatures and more days of extreme high temperatures, increased evaporation from soil, more intense and frequent drought, and increased risk and severity of wildfires. In general, climate change effects would increase between 2020 and 2050. Climate change effects in the San Diego region are discussed in more detail in Appendix F.

2020

Regional Growth and Land Use Change

High erosion potential in soils is primarily caused by loose soils and steep slopes, therefore, as stated in 4.7.1, the potential for erosion is most common in beachside areas subject to wave action, such as Del Mar, Solana Beach, and Encinitas. The potential for erosion generally increases as a result of human activity, primarily through development of structures and impervious surfaces and the removal of vegetative cover. As shown on Figure 2.0-11, regional growth and land use changes by 2020 would occur in coastal areas prone to wave action and erosion.

Additionally, regional growth and land use change associated with the proposed Plan would cause erosion due to a greater degree of exposed graded surfaces, excavation, stock piling, or boring associated with construction of development projects. Most regional growth and land use change projects would require cut-and-fill grading, and cut-and-fill grading associated with new development and redevelopment would result in manufactured slopes that become unstable over time and increase long-term erosion potential. Growth by 2020 would mainly take place in existing urban areas, which may increase the susceptibility of soil erosion or loss of topsoil in erosion-prone areas, such as along the coast. New development may disturb soils in previously undisturbed areas. New development or redevelopment may also cause higher amounts of water runoff, which can cause or exacerbate soil erosion and loss of topsoil.

Soil erosion or loss of topsoil in the San Diego region is primarily regulated through the CBC and the grading regulations of local jurisdictions. The CBC requires special foundation engineering and investigation of soils on proposed development sites located in geologic hazard areas. These reports must demonstrate that the hazard presented by the project will be eliminated or that there is no danger for the intended use. To minimize soil erosion or loss of topsoil, a grading permit must be obtained for all major earth-moving projects. The 18 cities and county government have grading regulations designed in part to ensure that development in earthquake- or landslide-prone areas does not threaten human life or property. Many of the region’s most erosion-prone areas occur along the coastal bluffs, which are within Coastal Zone and regulated under the California Coastal Act. The Act requires the inclusion of grading, drainage, and erosion control plans with the submittal of a development application, and allows for construction altering the natural shoreline when required to when required to protect existing structures or public beaches in danger from erosion. The Act also states that new development shall assure stability and structural integrity, and neither create nor contribute significantly to erosion (CCC 2014)

Erosion impacts resulting from construction would be primarily addressed through compliance with the Construction General Permit, described in Section 4.7.2. A SWPPP would be implemented for any ground disturbance greater than 1 acre and would be required prior to disturbing and exposing soil. The SWPPP would include construction site BMPs to reduce the amount of soil disturbance and control erosion and sediment transport.
Adherence to the CBC, coastal zone regulations, construction general permit requirements (e.g., SWPPPs), and local grading and erosion control ordinances would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**Transportation Network Improvements and Programs**

Some or portions of the transportation network improvements and programs included in the proposed Plan would be constructed on or in proximity to steep slopes and would increase the amount of impervious surfaces and the removal of additional vegetative cover. Some transportation or transit projects associated with the proposed Plan could require substantial earthwork, including cuts into hillsides that can become unstable over time, increasing long-term soil erosion potential. Road cuts can expose soils to erosion over the life of the project, creating potential landslide and falling rock hazards. Engineered roadways can be undercut over time by storm water drainage. Some areas would be more susceptible to erosion than others due to the naturally occurring soils with high erosion characteristics. Transportation network improvements and programs implemented by 2020 may cause or worsen soil erosion or loss of topsoil, particularly if those improvements require substantial earthwork.

Heavy construction operations can cause substantial groundborne vibration in proximity to the source. High impact or heavy equipment, such as pile drivers or large bulldozers, can generate high vibration levels. The primary vibration sources associated with transportation system operations include heavy truck and bus traffic along roadways and train traffic along rail lines. Vibration from new or expanded highways or transit lines, or rail ways, such as two new managed lanes along I-5 and I-805, new toll lanes on SR 11, and two new general purpose lanes on SR 76; widening and extensions of regional arterials; and double-tracking the LOSSAN railway corridor, may also cause or exacerbate soil erosion along hillsides in canyons or coastal bluffs. Noise and vibration are further discussed in Section 4.12.

Each transportation network improvement and program would be reviewed by appropriate regulatory agencies prior to construction and would adhere to design standards described in the CBC and all standard design, grading, and construction practices (e.g., Construction General Permit) to avoid or reduce soil erosion or loss of topsoil. Adherence to these regulations would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**2020 Conclusion**

Compliance with regulatory requirements and implementation of required design measures would ensure that regional growth and land use changes as well as transportation network improvements and programs associated with the proposed Plan would not cause substantial soil erosion or the loss of topsoil; therefore, this impact (GEO-3) in the year 2020 is less than significant.

**2035**

**Regional Growth and Land Use Change**

Impacts would occur in 2035 where regional growth is forecasted to occur in coastal areas or in areas near or in canyons. As stated in the 2020 analysis, the potential for erosion and loss of topsoil increases with human activity and development or redevelopment. Activities such as grading, excavation, stock piling, boring, and cut-and-fill grading can increase erosion potential and loss of topsoil.
Additionally, as described in the 2020 analysis, an increase in volume or velocity of storm water can increase erosion potential and loss of topsoil. Adherence to the CBC, coastal zone regulations, construction general permit requirements, and local grading and erosion control ordinances would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**Transportation Network Improvements and Programs**

As stated above, some of the transportation network improvements and programs would cause or worsen soil erosion or loss of topsoil, particularly if those improvements require substantial earthwork, such as below-grade transit line extensions or routes. Vibration may also cause or exacerbate soil erosion and loss of topsoil along hillsides in canyons or coastal bluffs. Particular projects located in coastal areas, such as additional managed lanes along I-5, and LOSSAN rail corridor double tracking would be susceptible to causing soil erosion impacts and loss of topsoil from vibration impacts.

Each improvement or program would be reviewed by appropriate regulatory agencies prior to construction and would adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce soil erosion or loss of topsoil. Adherence to these regulations would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**2035 Conclusion**

Compliance with regulatory requirements and implementation of required design measures would ensure that regional growth and land use changes as well as transportation network improvements and programs associated with the proposed Plan would not cause substantial soil erosion or the loss of topsoil; therefore, this impact (GEO-3) in the year 2035 is less than significant.

**2050**

**Regional Growth and Land Use Change**

Impacts may be greater by 2050 than by 2020 or 2035 as additional growth is forecasted to occur in coastal areas or in areas near or in canyons. As stated in the 2020 and 2035 analyses, the potential for erosion and loss of topsoil increases with human activity and development or redevelopment. Activities such as grading, excavation, stock piling, boring, and cut-and-fill grading can increase erosion potential and loss of topsoil. Additionally, as described in the 2020 analysis, an increase in volume or velocity of storm water can increase erosion potential and loss of topsoil. Adherence to the CBC, coastal zone regulations, construction general permit requirements, and local grading and erosion control ordinances would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**Transportation Network Improvements and Programs**

As stated in the 2020 and 2035 analyses, some of the transportation network improvements and programs would cause or worsen soil erosion or loss of topsoil, particularly if those improvements require substantial earthwork, such as below-grade transit line extensions or routes.
Vibration may also cause or exacerbate soil erosion or loss of topsoil along hillsides in canyons or coastal bluffs, such as portions of I-5, as well as SR 15, I-15, I-805, SR 52, SR 54, SR 56, SR 67, SR 76, SR 94, and SR 125, and rail projects. Specific transportation improvements that may cause or exacerbate soil erosion and loss of topsoil would be the projects along the southern coast and canyon areas, and expansion of Trolley lines near the coast. The greatest impacts from construction would likely occur by 2035, although impacts from operation of transportation improvements would be greatest by 2050 as all transportation network improvements and programs would be implemented by that time.

Each improvement or program would be reviewed by appropriate regulatory agencies prior to construction and would adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce soil erosion or loss of topsoil. Adherence to these regulations would reduce the potential for substantial soil erosion or loss of topsoil and impacts would be less than significant.

**2050 Conclusion**

Compliance with regulatory requirements and implementation of required design measures would ensure that regional growth and land use changes as well as transportation network improvements and programs associated with the proposed Plan would not cause substantial soil erosion or the loss of topsoil; therefore, this impact (GEO-3) in the year 2050 is less than significant.

**GEO-4 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, POTENTIALLY CAUSING ADVERSE GROUNDWATER IMPACTS.**

**ANALYSIS METHODOLOGY**

Areas not serviced by wastewater districts typically have septic systems, also referred to as OWTS, for wastewater disposal. The most common type of septic system found in the San Diego Region consists of a septic tank connected to leach lines. Areas with OWTS, rather than sewer connections, include the unincorporated County communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa.

The general locations of development under the proposed Plan in areas without sewer systems that rely on OWTS are identified. A regulatory discussion is included, including County policies for permitting of septic systems and their ability to protect groundwater quality.

Transportation network improvements and programs would not cause impacts to septic systems or OWTS, as facilities associated with transportation network improvements and programs would not use septic systems, and therefore are not be addressed further in this impact analysis.
Regional Growth and Land Use Change

As described below, regional growth and land use change associated with implementation of the proposed Plan would occur in areas containing expansive soils, or soils incapable of supporting the use of septic tanks or OWTS, thereby causing adverse groundwater impacts. If the moisture content and/or soil type differs at various locations supporting a septic tank or alternative wastewater disposal system, localized or nonuniform movement may occur. This movement can cause damage to the septic tank or alternative wastewater disposal system. Damage caused by expansive soils can be slow and long term, and not attributable to any particular event. The issue of expansive soils, or soils incapable of adequately supporting septic tanks or OWTS, is not as common in the San Diego region as in other parts of the country; however, development that occurs near the coast would be more susceptible to damage caused by expansive soils than eastern areas of the region, where the use of septic systems is more common. Expansive soils, as described in 4.7.1, are not confined to the coastal areas, however. The most common type of septic system found in the San Diego Region consists of a septic tank connected to leach lines. Areas with OWTS, rather than sewer connections, include the unincorporated communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa. Of these unincorporated communities, North County Metro, Fallbrook, Spring Valley, Ramona, and Valley Center are the communities with the highest proportion of the County’s forecasted population and housing unit increases by 2020, and although are not coastal communities, they do have the potential for expansive soils. The North County Metro area has potential expansive soils mapped in the northern part of the community, while Fallbrook and Spring Valley both have potential expansive soils throughout their boundaries. Valley Center has potential expansive soils throughout the community, and Ramona has a concentration of potential expansive soils in the heart of the community, surrounding SR 67 (County of San Diego 2011). Therefore, in certain unincorporated communities with forecasted housing unit and population growth by 2020, there would be development on soils incapable of supporting septic tanks or OWTS.

On April 15, 2015, the San Diego RWQCB adopted a Basin Plan amendment that changed water quality objectives for nitrate in groundwater basins. The Basin Plan Amendment also incorporates the State Water Quality Control Policy for Siting, Designing, Operation, and Maintenance of Onsite Wastewater Treatment Systems and made updates related to implementation of waste discharge requirements and adopted resolutions (Gorham 2015). The Basin Plan Amendment incorporates the OWTS Policy into the Basin Plan, and amends the criteria to be used by the San Diego Water Board and local agencies to regulate OWTS in the San Diego Region (SDRWQCB 2015).

To reduce adverse impacts to groundwater, the San Diego RWQCB authorizes the County of San Diego Department of Environmental Health to issue septic system (OWTS) permits throughout the County. The purpose of regulating the design, installation, and maintenance of septic systems is to prevent public health nuisance conditions caused by failing septic systems. The program’s goals are to:

- Ensure that these systems can operate in all weather conditions with minimal maintenance;
- Prevent the contamination of groundwater from improperly designed onsite wastewater treatment systems;
- Prevent the contamination of surface water from improperly designed onsite wastewater treatment systems, and
• Prevent premature failure of onsite wastewater treatment systems.

Through adherence to existing laws and regulations, regional growth and land use change associated with the proposed Plan would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce adverse groundwater impacts associated with expansive soils, or soils incapable of adequately supporting the use of septic tanks and alternative wastewater disposal systems, as described in Section 4.7.2. Corrective measures would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies and consistent with regulatory requirements would ensure that new septic tanks or alternative wastewater disposal systems associated with regional growth and land use change would not result in adverse groundwater impacts due to incapable soils. This impact is less than significant.

2020 Conclusion

Implementation of regional growth and land use change associated with the proposed Plan would occur on expansive or unstable soils incapable of supporting the use of septic tanks or OWTS; however, adherence to the laws and regulations included in Section 4.7.2 and described above would minimize the potential for adverse impacts to groundwater. Therefore, this impact (GEO-4) is less than significant in the year 2020.

2035

Regional Growth and Land Use Change

The issue of expansive soils, or soils incapable of adequately supporting septic tanks or OWTS, is not as common in the San Diego region as in other parts of the country; however, development that occurs near the coast would be more susceptible to damage caused by expansive soils than eastern areas of the region, where the use of septic systems is more common. Expansive soils, as described in 4.7.1, are not confined to the coastal areas, however. Areas with OWTS, rather than sewer connections, include the unincorporated communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa. Of these unincorporated communities, in 2035 the communities with the highest proportion of the County’s forecasted population and housing unit increases include Lakeside, North County Metro, Fallbrook, Spring Valley, and Ramona. As stated in the 2020 analysis, North County Merto, Fallbrook, Spring Valley, and Ramona all have potential expansive soils throughout their communities. Lakeside also has potential expansive soils along the eastern and southern community boundaries (County of San Diego 2011). Therefore, in certain parts of all of the unincorporated communities with forecasted regional population and housing unit growth by 2035, there would be development on soils incapable of supporting septic tanks or OWTS.

Additionally, areas with high groundwater levels can also cause unstable soils and may not be able to support the use of septic tanks or alternative wastewater disposal systems potentially causing adverse groundwater impacts. Since high groundwater levels occur mainly in the western part of the region, where reliance on these systems is not common and where land use is not anticipated to change substantially through 2035, regional growth and land use change associated with the proposed Plan in this area would not 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, potentially causing adverse groundwater impacts.

As mentioned above, all projects associated with regional growth and land use change under the proposed Plan would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce adverse groundwater impacts from expansive soils or soils incapable of supporting the use of septic tanks or OWTS. Regulatory agencies with oversight on regional growth and land use change associated with the proposed Plan have developed regulations and engineering design specifications to reduce risks from expansive soils or soils incapable of supporting the use of septic tanks or OWTS. Corrective measures would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies and consistent with regulatory requirements would ensure that new septic tanks or alternative wastewater disposal systems associated with regional growth and land use change would not result in adverse groundwater impacts due to incapable soils. This impact is less than significant.

2035 Conclusion

Implementation of regional growth and land use change associated with the proposed Plan would occur on expansive or unstable soils incapable of supporting the use of septic tanks or alternative wastewater disposal systems; however, adherence to the laws and regulations included in Section 4.7.2 and described above would minimize the potential for adverse impacts to groundwater. Therefore, this impact (GEO-4) is less than significant in the year 2035.

2050

Regional Growth and Land Use Change

The issue of expansive soils, or soils incapable of adequately supporting septic tanks or OWTS, is not as common in the San Diego region as in other parts of the country; however, development that occurs near the coast would be more susceptible to damage caused by expansive soils than eastern areas of the region, where the use of septic systems is more common. Expansive soils, as described in 4.7.1, are not confined to the coastal areas, however. Areas with OWTS, rather than sewer connections, include the unincorporated communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa. As described in Section 4.11.4, Land Use, of these unincorporated communities, in 2050 the communities forecasted to have new growth and land use change over 2035 are North Mountain, Ramona, Julian, Rainbow, Valley Center, Bonsall, Fallbrook, and North County Metro. As stated in the 2020 analysis, North County Metro, Fallbrook, and Ramona all have potential expansive soils throughout their communities. Therefore, in certain parts of all of the unincorporated communities with forecasted regional population and housing unit growth by 2050, there would be development on soils incapable of supporting septic tanks or OWTS.

As discussed in the 2020 and 2035 analyses above, additional growth and land use change would be susceptible to the effects of expansive soils or soils incapable of supporting the use of septic tanks or OWTS, particularly development located in coastal communities and unincorporated communities where expansive soils are located.
Additionally, areas with high groundwater levels can also cause unstable soils and may not be able to support the use of septic tanks or alternative wastewater disposal systems. Since high groundwater levels occur mainly in the western part of the region, where reliance on these systems is not common and where land use is not anticipated to change substantially through 2050, regional growth and land use change associated with the proposed Plan in this area would not be expected to 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, potentially causing adverse groundwater impacts.

As mentioned above, all projects associated with regional growth and land use change under the proposed Plan would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce adverse impacts to groundwater from expansive soils or soils incapable of supporting the use of septic tanks or OWTS. Regulatory agencies with oversight on regional growth and land use change associated with the proposed Plan have developed regulations and engineering design specifications to reduce risks from expansive soils. Corrective measures would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies and consistent with regulatory requirements would ensure that new septic tanks or alternative wastewater disposal systems associated with regional growth and land use change would not result in adverse groundwater impacts due to incapable soils. This impact is less than significant.

**2050 Conclusion**

Implementation of regional growth and land use change associated with the proposed Plan would occur on expansive or unstable soils incapable of supporting the use of septic tanks or alternative wastewater disposal systems; however, adherence to the laws and regulations included in Section 4.7.2 and described above would minimize the potential for adverse impacts to groundwater. Therefore, this impact (GEO-4) is less than significant in the year 2050.

**MR-1 RESULT IN THE LOSS OF AVAILABILITY OF KNOWN AGGREGATE AND MINERAL RESOURCES THAT WOULD BE OF VALUE TO THE REGION AND THE RESIDENTS OF THE STATE, OR RESULT IN THE LOSS OF AVAILABILITY OF A LOCALLY-IMPORTANT MINERAL RESOURCE RECOVERY SITE DELINEATED IN A LOCAL GENERAL PLAN, SPECIFIC PLAN, OR OTHER LAND USE PLAN.**

**ANALYSIS METHODOLOGY**

A significant impact to mineral resources would occur if land use change or a transportation project results in the loss of availability of land containing known mineral resources, or loss of availability of a locally important mineral resource recovery site delineated in a local plan, caused by the development of incompatible uses that directly or indirectly makes the resource inaccessible for future extraction. In addition to MRZ data, information found in the 2011 San Diego Region Aggregate Supply Study further identifies aggregate resources within the region. The impact analysis identifies these resources, and overlays regional growth and transportation projects to identify where the proposed Plan directly or indirectly impact such resources. Impacts to MRZ-2 lands are then quantified for each horizon year using data compiled from CGS. Appendix J summarizes the undeveloped MRZ-2 lands converted to developed land and transportation network improvements for each horizon year.
2020

**Regional Growth and Land Use Change**

Lands designated as MRZ-2 locations are areas of known mineral resources. As shown in Figure 4.7-3, MRZ-2 locations exist along SR 76, between I-15 and SR 78; north of SR-52 east of I-805; along I-8 and SR 125; between SR 56 and SR 52; in south Chula Vista and Otay Mesa; from Imperial Beach south to the U.S./Mexican border; scattered along I-15; and in San Diego between the I-805, SR 905, and I-5. Resource recovery sites are areas where mineral resources could be extracted for use. Locally important resource recovery sites or areas where important resource recovery sites could potentially be located, or where mines are currently operating, are designated by the CGS as MRZ-2 or MRZ-3 as shown on Figure 4.7-3. In 2020, regional growth and land use changes would result in loss of approximately 1,900 acres of undeveloped MRZ-2 land to developed land throughout the region, resulting in the loss of known mineral resources and mineral resource recovery sites over 2012 conditions (CGS 1996, 2006).

Permanent loss of availability to land containing mineral resources in the region is caused by the development of incompatible uses, which directly or indirectly makes the resource inaccessible for future extraction. To accommodate regional growth and land use change by 2020, portions of vacant and undeveloped land in MRZ-2 locations would be developed for land uses considered incompatible with mining operations.

Although there are several places in the San Diego region where active mining operations have functioned in proximity to urban development, such as Mission Valley or Carroll Canyon in the City of San Diego, residential development typically restricts the availability of lands for mining operations. Noise from quarry and mining activities is typically the largest environmental impact to nearby noise-sensitive land uses (such as residential developments, industrial developments, commercial developments, and major public facilities). Residents can be concerned about potential dust, noise, blasting vibrations, truck traffic, unsightly scars on the land, and loss of habitat caused by aggregate mining. Aggregate, a regionally important mineral resource, is found in portions of MRZ-2 locations, as seen in Figure 4.7-3. Aggregate along the SR 76 would coincide with spaced rural residential development in 2020, and aggregate located in the Santee vicinity would coincide with single family residential development in 2020.

Therefore, regional growth and land use change under the proposed plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and therefore this impact would be significant.

**Transportation Network Improvements and Programs**

Lands designated as MRZ-2 locations are areas of known mineral resources. As shown in Figure 4.7-3, MRZ-2 locations exist along SR 76, between I-15 and SR 78; north of SR-52 east of I-805; along I-8 and SR 125; between SR 56 and SR 52; in south Chula Vista and Otay Mesa; from Imperial Beach south to the U.S./Mexican border; scattered along I-15; and in San Diego between the I-805, SR 905, and I-5. In 2020, transportation network improvements would result in loss of approximately 90 acres of undeveloped MRZ-2 lands, primarily due to two new managed lanes on I-805 from SR 52 to Carroll Canyon Road and two new general purpose lanes on SR 76 from Mission Avenue to I-15, resulting in the loss of known mineral resources and mineral resource recovery sites over 2012 conditions (CGS 1996, 2006).
Therefore, transportation network improvements under the proposed Plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and, therefore this impact would be significant.

2020 Conclusion

Implementation of regional growth and land use change, as well as transportation network improvements and programs, would result in the loss of availability of known aggregate or other mineral resources, as well as the loss of availability of locally-important mineral resource recovery sites, including loss of over 2,000 acres of MRZ-2 lands. Therefore, this impact (MR-1) is significant in the year 2020.

2035

Regional Growth and Land Use Change

Additional vacant and undeveloped land in MRZ-2 locations would be developed for uses considered incompatible with mining operations. Development to accommodate regional growth and land use change would be constructed throughout the region. From 2012 to 2035, regional growth and land use changes would result in loss of approximately 4,000 acres of undeveloped MRZ-2 land throughout the region, resulting in the loss of known mineral resources and mineral resource recovery sites (CGS 1996, 2006). Aggregate along the SR 76 would coincide with spaced rural residential development and single family residential development in 2035, and aggregate located in the Santee vicinity would coincide with single family residential and education institution development in 2035.

Therefore, regional growth and land use change under the proposed plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and therefore this impact would be significant.

Transportation Network Improvements and Programs

Transportation network improvements and programs associated with the proposed Plan implemented by 2035 would require increased right-of-way within MRZ-2 locations, which would potentially limit areas within those zones that could be used for mining operations. Transportation network improvements and programs built or implemented in MRZ-2 locations would potentially decrease land available for mining operations. From 2012 to 2035, transportation network improvements would result in loss of approximately 266 acres of undeveloped MRZ-2 land, primarily due to managed lanes, general purpose lanes, and the Trolley extension from San Ysidro to Kearny Mesa, resulting in the loss of known mineral resources and mineral resource recovery sites (CGS 1996, 2006). Therefore, transportation network improvements under the proposed plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and therefore this impact would be significant.
2035 Conclusion

Implementation of regional growth and land use change, as well as transportation network improvements and programs, would result in the loss of availability of known aggregate or other mineral resources, as well as the loss of availability of locally-important mineral resource recovery sites, including loss of nearly 4,300 acres of MRZ-2 lands. Therefore, this impact (MR-1) is significant in the year 2035.

2050

Regional Growth and Land Use Change

Additional vacant and undeveloped land in MRZ-2 locations would be developed for uses considered incompatible with mining operations. Development to accommodate regional growth and land use change would be constructed throughout the region. Some of the land in MRZ-2 locations would also be protected for habitat preservation. From 2012 to 2050, regional growth and land use change would result in loss of approximately 5,600 acres of undeveloped MRZ-2 land to developed land throughout the region, resulting in the loss of known mineral resources and mineral resource recovery sites (CGS 1996, 2006). Aggregate along the SR 76 would coincide with spaced rural residential development and single family residential development in 2050, and aggregate located in the Santee vicinity would coincide with single family residential and education institution development in 2050. Therefore, regional growth and land use change under the proposed plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and therefore this impact would be significant.

Transportation Network Improvements and Programs

Transportation network improvements by 2050 would require increased right-of-way within MRZ-2 locations, which would limit areas within those zones that could be used for mining operations. Transportation improvements and programs that occur in MRZ-2 locations would decrease land available for mining operations. From 2012 to 2050, transportation network improvements would result in loss of over 620 acres of undeveloped MRZ-2 land, primarily due to new managed lanes, new general purpose and toll lanes, and the Trolley extensions from Pacific Beach to Balboa, Balboa to Kearny Mesa, and Kearny Mesa to the El Cajon Transit Center, resulting in the loss of known mineral resources and mineral resource recovery sites (CGS 1996, 2006). Therefore, transportation network improvements under the proposed plan would result in the loss of availability of known aggregate and mineral resources that would be of value to the region and the residents of the state, and result in the loss of availability of a locally-important mineral resource recovery site delineated in a local general plan, specific plan, or other land use plan, and therefore this impact would be significant.

2050 Conclusion

Implementation of regional growth and land use change, as well as transportation network improvements and programs, would result in the loss of availability of known aggregate or other mineral resources, as well as the loss of availability of locally-important mineral resource recovery sites, including loss of nearly 6,200 acres of MRZ-2 lands. Therefore, this impact (MR-1) is significant in the year 2050.
MITIGATION MEASURES

MR-1 LOSS OF KNOWN AGGREGATE AND MINERAL RESOURCES OF REGIONAL OR STATE VALUE, OR LOCALLY-IMPORTANT MINERAL RESOURCE RECOVERY SITES

2020, 2035, and 2050

MR-1A CONSERVE AGGREGATE AND MINERAL RESOURCES. During planning, design, and project-level CEQA review of transportation network improvements, SANDAG shall, and other transportation project sponsors can and should, avoid loss of known aggregate and mineral resources or locally important mineral resource recovery sites. Where avoidance is infeasible, SANDAG shall, and other transportation project sponsors can and should, minimize impacts to the availability of known resources and recovery sites through measures that include, but are not limited to, the following:

- Designing transportation network improvements in a manner (such as buffer zones or the use of screening) that does not preclude adjacent or nearby extraction of known mineral and aggregate resources following completion of the improvement and during long-term operations.

In addition, during planning, design, and project-level CEQA review of development projects, the County of San Diego, cities, and other local jurisdictions can and should avoid or reduce impacts on known aggregate and mineral resources and mineral resource recovery sites through the evaluation and selection of project sites and design features (e.g., buffers) that minimize impacts on land suitable for aggregate and mineral resource extraction by maintaining portions of MRZ-2 areas in open space or other general plan land use categories and zoning that allow for mining of mineral resources.

SIGNIFICANCE AFTER MITIGATION

2020, 2035, 2050

Significant and Unavoidable

Mitigation measure MR-1A would reduce the impact associated with the loss of availability of known mineral resources and mineral resource recovery sites, but not to less than significant levels because mitigation measure MR-1A would not prevent impacts to all MRZ-2 zoned lands. Additionally, design features that reduce the impact associated with the loss of availability of known mineral resources and mineral resource recovery sites may not reduce impacts to less than significant for all projects. Therefore, this impact (MR-1) remains significant and unavoidable.