

SECTION 4.5

GEOLOGY AND SOILS

This section describes federal, state and local regulations applicable to geology and soils. It also describes the environmental setting of the Project area with regard to the soils, seismicity and geologic conditions, focusing on the Project parcels. A discussion of geology and soil impacts is also provided and mitigation measures are identified as appropriate. The analysis in this section is based on the *Soil Survey of Imperial County, California, Imperial Valley Area* (USDA 1981) and the "Preliminary Geotechnical and GeoHazards Report, Four Vacant Lots NEC Cole Road and Sunset Blvd, Calexico, California" (LandMark 2018). This document is included as **Appendix E** of the Technical Appendices of this EIR on the attached CD.

4.5.1 REGULATORY FRAMEWORK

A. STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Zoning Act (Chapter 7.5, Division 2, Public Resources Code, State of California, effective May 4, 1975) provides a statewide mechanism for reducing losses from surface fault rupture. The Act promotes public safety by prohibiting siting of most structures for human occupancy across traces of active faults that constitute a hazard to structures from surface faulting or fault creep. In accordance with the Act, the Office of State Geologist delineated Special Study Zones that encompass potentially and recently active traces of four major faults: San Andreas, Calaveras, Hayward and San Jacinto.

According to the Safety Element of the City of Calexico General Plan, the City of Calexico is not located within an Alquist-Priolo Earthquake Fault Zone (City of Calexico 2015, p. 8-2). Review of the current Alquist-Priolo Earthquake Fault Zone maps indicates that the nearest mapped Earthquake Fault Zone is Imperial fault located approximately 6.3 miles east of the Project parcels (refer to **Figure 4.5-1**) (LandMark 2018, p. 5).

California Building Code

The City of Calexico references the Uniform Building Code (UBC) in its policies regarding seismic safety. The UBC was replaced in 2000 by the new International Building Code (IBC) published by the International Code Council (ICC). The IBC merged three different building codes into a consolidated code. In addition, Title 24 of the California Code of Regulations (CCR), commonly referred to as the California Building Code (CBC), is published and updated by the California Building Standards Commission. The most recent version of the CBC (2016) went into effect as of January 1, 2017. Cities and counties are required by state law to enforce CCR Title 24. Title 24 applies to all building occupancies, and related features and equipment throughout the State of California, and contains requirements related to the structural, mechanical, electrical, and plumbing systems, and requires measures for energy conservation, green design, construction and maintenance, fire and life safety, and accessibility. Among other elements, Chapter 16 of this code dictates the design and construction standards applicable to resist seismic shaking of structures. The Project would also be subject to compliance with the 2016 CBC.

Surface Mining and Reclamation Act

The Surface Mining and Reclamation Act (SMARA) of 1975 acknowledges that mineral extraction is essential to California's economy and that the reclamation of mined lands after extraction is necessary to prevent or minimize adverse effects on the environment and to protect the public health and safety. SMARA also classifies mineral resources in the State and provides information to local governments regarding mineral resources. Designating lands that contain regionally significant mineral resources is the responsibility of local governments. Typically, local governments preserve such areas from encroachment or conversion to other uses as part of the General Plan. The law has resulted in the preparation of Mineral Land Classification Maps delineating Mineral Resource Zones (MRZ) for aggregate resources (sand, gravel, and stone). As of March 2013, Imperial County is one of 14 counties in California within which no SMARA

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classification has occurred (City of Calexico 2015a, p. 5-12). The State Department of Conservation mapped seven principal mineral producing locations in the County of Imperial that included sand, gravel, gypsum, clay and gold. Two locations where clay, sand and gravel are mined, are located in proximity to, but not within the City of Calexico.

B. LOCAL

City Codes and Ordinances

The City of Calexico has adopted all the UBC and uses the UBC seismic design standards for all buildings developed in the City. The City acts to adopt new codes as they are published. Compliance with the most recent version of the UBC, including the structural requirements for new buildings, greatly increases the chance that a structure will endure an earthquake with little or no significant damage (City of Calexico 2015, p. 8-6).

City of Calexico General Plan

The Calexico General Plan has been prepared to fulfill the requirement of California law that each city adopt a comprehensive General Plan to guide physical development of the incorporated area and land outside of the municipal boundaries.

The Safety Element of the Calexico General Plan establishes policies and programs to protect the community from risk associated with geologic hazards (including earthquakes and secondary hazards), flooding, fire (both wildland and urban), hazardous materials, the New River, peak load water supply and emergency access. The goals, objectives, and policies provide direction for development. In addition, the Conservation/Open Space Element addresses conservation, development and utilization of natural resource. Calexico’s current General Plan dated February 2007 was adopted by the City on May 1, 2007.

Table 4.5-1 analyzes the consistency of the Project with the applicable goals, objectives and policies relating to seismic hazards and soil conditions in the City of Calexico General Plan. While this EIR analyzes the Project’s consistency with the General Plan pursuant to CEQA Guidelines Section 15125(d), the Calexico City Council ultimately determines consistency with the General Plan.

**TABLE 4.5-1
CITY OF CALEXICO GENERAL PLAN CONSISTENCY ANALYSIS**

General Plan Goals, Objectives and Policies	Consistent with General Plan?	Analysis
SAFETY ELEMENT		
8.5.1 Goal To identify and minimize, to the extent possible or feasible, the risks to persons and property caused by natural and human-induced hazards.		
8.5.1.1 Levels of Risk		
Objective 1 To maintain acceptable risk levels when conducting land use planning.		
Policy 1c: The City shall require a geologic/geotechnical investigation for all projects whose uses or intensities attain a Level of Acceptable Risk rating that exceeds “Ordinary” Levels (Levels 1, 2 & 3 – Refer to Table S-A), and must contain a site-specific evaluation of peak horizontal ground acceleration.	Yes	Although the proposed Project is considered to have a “Ordinary” level of risk to the occupants of the structure per Table S-A, the Applicant prepared a Preliminary Geotechnical and GeoHazards Report (LandMark 2018). The Report included a discussion of Peak Ground Acceleration. Therefore, the

**TABLE 4.5-1
CITY OF CALEXICO GENERAL PLAN CONSISTENCY ANALYSIS**

General Plan Goals, Objectives and Policies	Consistent with General Plan?	Analysis
		proposed Project is consistent with this policy.
8.5.1.2 Seismic Hazards		
Objective 2: All development in the City shall adhere to standards for grading and construction which reduce the potential of seismic hazards.		
Policy 2b: Consultation with a qualified engineering geologist shall be required for all development.	Yes	Steven K. Williams, Senior Engineering Geologist with LandMark Consultants, Inc. Prepared a Preliminary Geotechnical and GeoHazards Report for the Project parcels. Therefore, the proposed Project is consistent with this policy.
CONSERVATION/OPEN SPACE ELEMENT		
5.4.1 Conservation Goal: To balance development with preservation and management of natural and human-built open space resources, thus ensuring the long-term viability of the City.		
5.4.1.2 Soil Management		
Objective 2: The City shall continue using soil management techniques that minimize soil related problems, including erosion, shrink-swell behavior, and septic tank failure.		
Policy 2a. In order to reduce or eliminate soil erosion and pollution, the City shall ensure that construction activity is in compliance with the State's General Permit for Construction Activities administered by the California Regional Water Quality Control Board, located in Palm Desert (Region 7). One condition of this permit is the development and implementation of a site-specific Storm Water Pollution Prevention Plan ("SWPPP") that identifies Best Management Practices ("BMPs") to reduce/eliminate erosion and sedimentation associated with construction.	Yes	The proposed Project is greater than one acre in size and would be covered under a General Permit for Discharges of Storm Water Associated with Construction Activity (NPDES No. CAS000002) (Construction General Permit Order 2010-2014-DWQ, effective February 14, 2011). The permit requires the Applicants to file a public Notice of Intent (NOI) to discharge stormwater and to prepare and implement a SWPPP. Therefore, the proposed Project is consistent with this policy (refer to Section 4.8, Hydrology and Water Quality). Therefore, the proposed Project is consistent with this policy.
Policy 2b. All development requiring City discretionary approval shall provide a geotechnical investigation by a registered geotechnical engineer that discusses, at least, liquefaction, subsidence, shrink/swell potential, soil strength, landslide potential, distance to known fault rupture zones. All geotechnical studies shall be submitted	Yes	A Preliminary Geotechnical and GeoHazards Report was prepared for the Project parcels which addressed potential for liquefaction, subsidence, shrink/swell potential, soil strength, landslide potential, and distance to known fault rupture zones. The Report is included as Appendix E of this EIR and will be submitted to the City of Calexico for

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**TABLE 4.5-1
CITY OF CALEXICO GENERAL PLAN CONSISTENCY ANALYSIS**

General Plan Goals, Objectives and Policies	Consistent with General Plan?	Analysis
to the City of Calexico Building and Safety Department for review and approval.		review. In addition, mitigation measure MM 4.5.4 requires preparation of a site specific geotechnical investigation. Therefore, the proposed Project is consistent with this policy.
Policy 2c: Soils with moderate or high permeability capacity should be left in undeveloped (perhaps used as open space where appropriate) to reduce runoff and facilitate groundwater recharge.	Yes	The Project parcels do not have moderate to high permeability. Runoff will flow through city storm conveyance infrastructure to a retention basin in the Portico Industrial Park and ultimately discharge to the Stout Drain. Some groundwater recharge may occur in the retention basin. Therefore, the proposed Project is consistent with this policy.

4.5.2 ENVIRONMENTAL SETTING

A. PROJECT PARCELS

Geology

Regional

The Project parcels are located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and the Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments deposited since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. **Figure 4.5-1** shows the location of the Project parcels relative to regional earthquake faults and physiographic features (LandMark 2018, p. 2).

The Imperial Valley is directly underlain by lacustrine deposits which consist of interbedded lenticular and tabular silt, sand and clay. Based on the Unified Soil Classification System, the permeability of these soils is expected to be low to moderate. The Late Pleistocene to Holocene Lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla) (LandMark 2018, p. 2). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 – 20,000 feet (LandMark 2018, p. 2).

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Site-Specific

Faulting

The Project parcels are located in the seismically active Imperial Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinor Fault zones in southern California. The Imperial Fault represents a transition from the more continuous San Andreas Fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California (LandMark 2017, p. 4).

LandMark performed a computer-aided search of known faults or seismic zones that lie within a 36-mile (57 kilometer) radius of the Project parcels (LandMark 2018, p. 4). **Table 4.5-2** summarizes significant historic earthquake events on faults in the vicinity of the Project parcels. **Figure 4.5-2a** is a local fault map illustrating known active faults relative to the Project parcels. **Figure 4.5-2b** provides a legend to explaining the local fault map depicted in **Figure 4.5-2a**.

TABLE 4.5-2
SUMMARY OF CHARACTERISTICS OF CLOSEST KNOWN ACTIVE FAULTS TO THE PROJECT PARCELS

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Imperial	6.3	10.0	7	62+6	20+5
Brawley*	9.4	15.1			
Rico*	9.5	15.2			
Unnamed 2*	10.0	16.0			
Superstition Hills	10.4	16.6	6.6	23+2	4+2
Borrego (Mexico) *	13.0	20.8			
Cerro Prieto*	13.5	21.6			
Unnamed 1*	13.9	22.2			
Laguna Salada	14.8	23.6	7	67+7	3.5+1.5
Yuha*	15.0	24.1			
Pescadores (Mexico)*	16.2	25.9			
Superstition Mountain	16.7	26.7	6.6	24+2	5+3
Cucapha (Mexico)*	17.1	27.3			
Shell Beds	19.2	30.7			
Yuha Well*	19.8	31.6			
Vista de Anza*	22.2	35.5			
Panted Gorge Wash*	26.1	41.7			
Ocotillo*	27.3	43.7			
Elmore Ranch	30.4	48.6	6.6	29+3	1+0.5
Elsinore – Coyote Mountain	31.1	49.7	6.8	39+4	4+2
Algodones*	34.3	54.8			
San Jacinto - Borrego	35.8	57.2	6.6	23+3	4+2

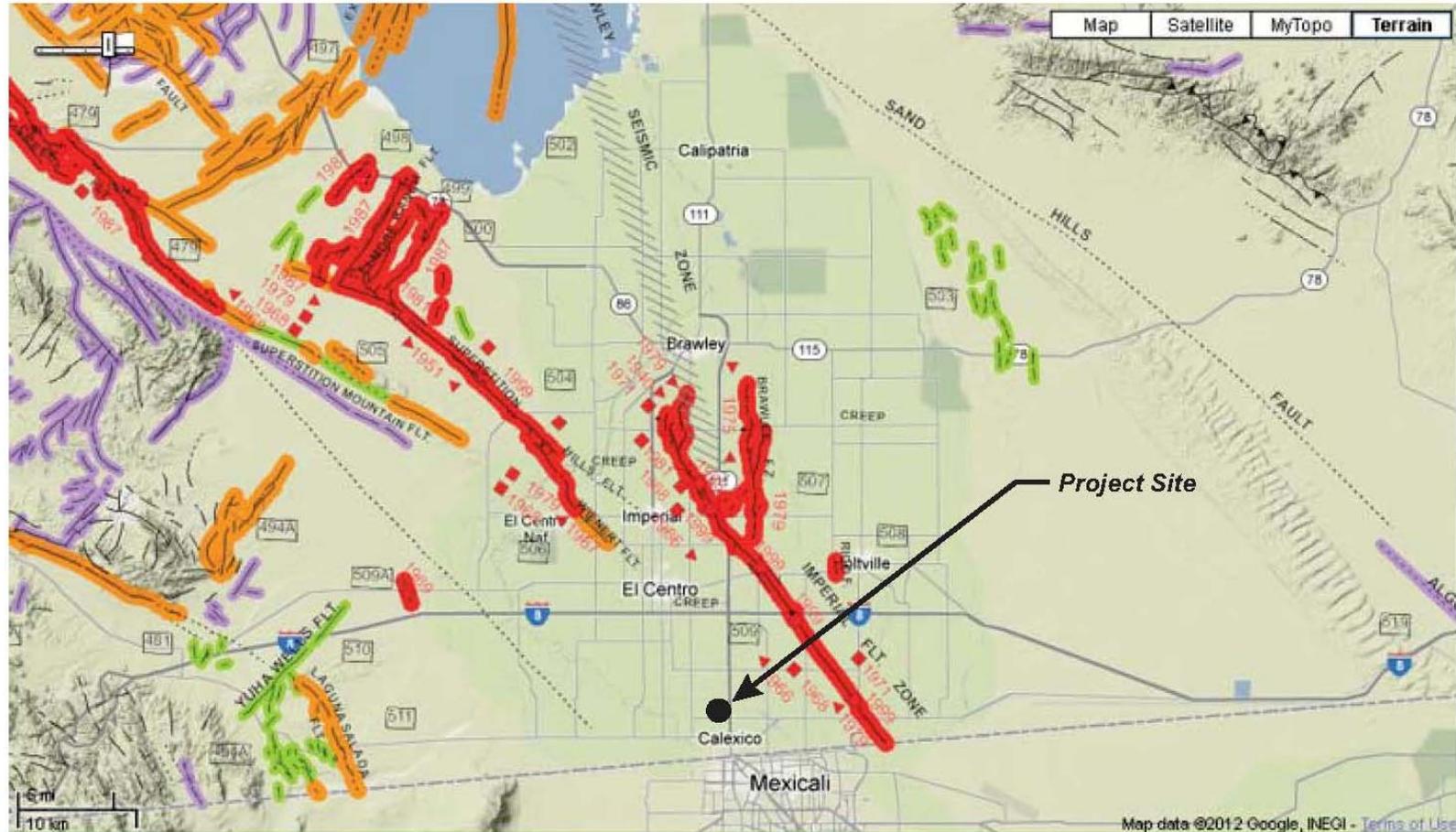
Source: LandMark 2018. *Faults not included in CGS database.



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/qmaps/FAM/faultactivity_map.html# in LandMark 2018.

**FIGURE 4.5-1
 REGIONAL FAULT MAP**

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Source: California Geological Survey 2010 Fault Activity Map of California
<http://www.quake.ca.gov/qmaps/FAM/faultactivity.map.html#> in LandMark 2018.

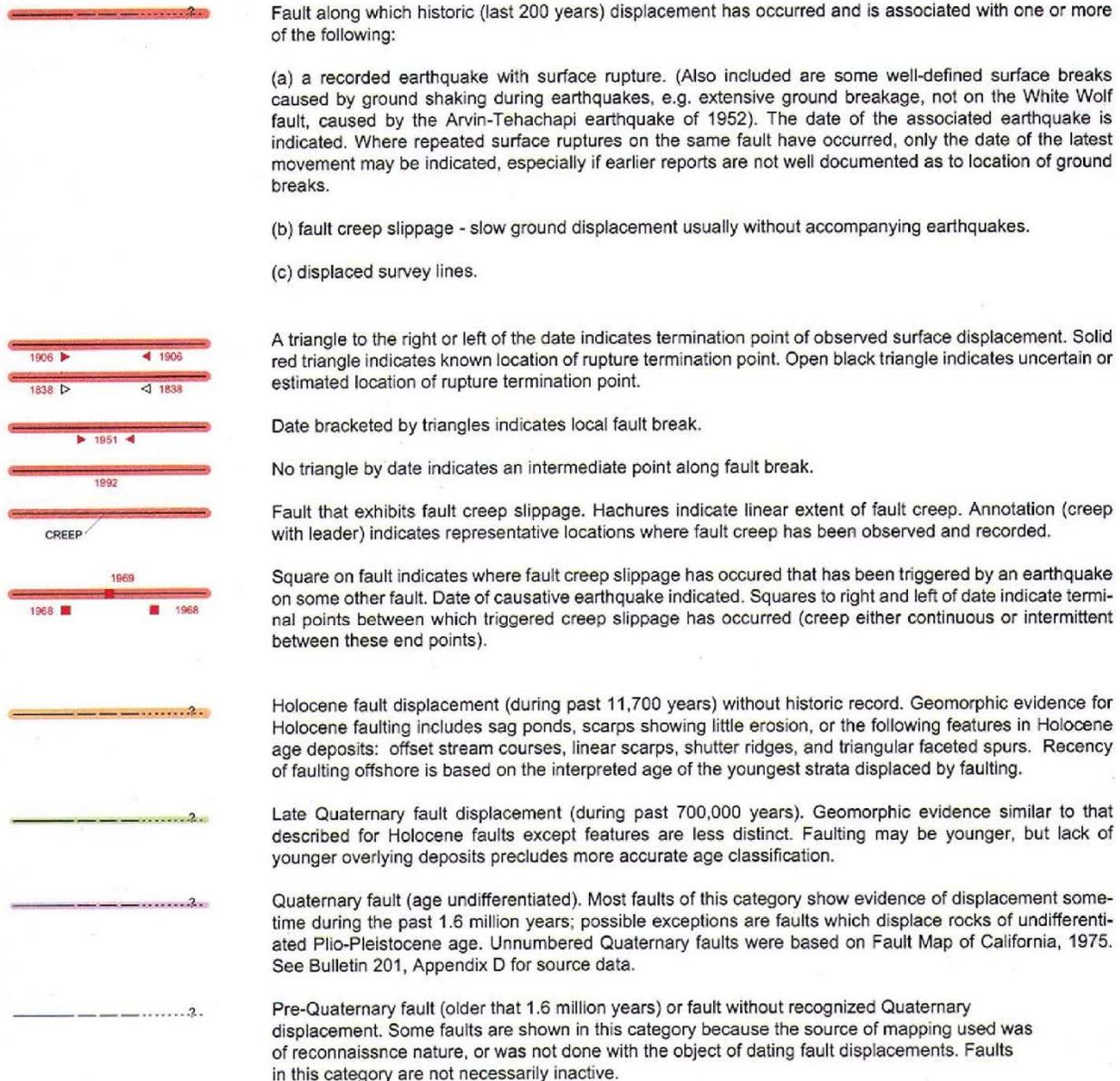
FIGURE 4.5-2A
MAP OF LOCAL FAULTS

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EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE (Indicating Recency of Movement)



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/qmaps/FAM/faultactivity_map.html# in LandMark 2018.

**FIGURE 4.5-2B
MAP OF LOCAL FAULTS - LEGEND**

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ADDITIONAL FAULT SYMBOLS

-  Bar and ball on downthrown side (relative or apparent).
-  Arrows along fault indicate relative or apparent direction of lateral movement.
-  Arrow on fault indicates direction of dip.
-  Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

-  Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.
-  Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.
-  Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale	Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
				ON LAND	OFFSHORE
Quaternary	Historic			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
	200			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	700,000			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary	1,600,000			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
	4.5 billion (Age of Earth)				

*Quaternary now recognized as extending to 2.6 Ma. Quaternary faults in this map were established using the previous 1.6 Ma Criterion.

Source: California Geological Survey 2010 Fault Activity Map of California http://www.quake.ca.gov/qmaps/FAM/faultactivity_map.html#inLandMark2018.

FIGURE 4.5-2B
MAP OF LOCAL FAULTS - LEGEND

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The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time) but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during both Pleistocene and Holocene time (that is no movement within the last 1.8 million years) is considered to be inactive (LandMark 2018, p. 4). Review of the current Alquist-Priolo Earthquake Fault Zone maps indicates that the nearest mapped Earthquake Fault Zone is the Imperial Fault located approximately 6.3 miles east of the Project parcels (LandMark 2018, p. 5).

Groundwater

The groundwater in the vicinity of the Project parcels is brackish and typically encountered at a depth of between 10 to 15 feet below ground surface. The accuracy of short-term water level measurements, particularly in fine-grained soils, is uncertain (LandMark 2018, p. 2).

Groundwater levels may fluctuate with precipitation, irrigation or adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition (LandMark 2018, p. 3).

Landslides

Ground failure occurs from the shock of an earthquake and is almost exclusively manifest in the form of a landslide. Landslides are caused by the combination of gravity and poor geologic conditions along with a seismic event (City of Calexico 2015, p. 8-5). No ancient landslides are shown on the geologic maps of the region and no indications of landslides were observed during the site investigation of the Project parcels. The hazard of landsliding is unlikely due to the relatively planar topography of the Project parcels (LandMark 2018, p. 3). Moreover, the Calexico General Plan Safety Element indicates that Calexico is not susceptible to landslides due to its flat topography (City of Calexico 2015a, p. 8-5).

Expansive Soils

Expansive soils are primarily comprised of clay particles. Clay increases in volume when water is absorbed and shrinks when dry. Expansive soils can damage building foundations, concrete flatwork and asphaltic concrete pavements as a result of swelling forces that reduce soil strength. Much of the near surface soils within the Project parcels consist of silty clays and clay with a moderate to high expansion potential (LandMark 2018, p. 3).

Corrosive Soils

All lacustrine site soils (lake bed deposits) in which the Imperial Valley is formed are moderately to highly corrosive to steel and concrete (LandMark 2018, p. 3). Corrosive soils typically have high moisture content, electrical conductivity, acidity and dissolved salts.

Liquefaction/Seismic Settlement

Liquefaction is a potential design consideration because of possible saturated sandy substrata underlying the Project parcels. Liquefaction occurs when granular soils below the water table are subjected to vibratory motions such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soils behaves as a liquid similar to quicksand (LandMark 2018, p. 3). Seismic settlement refers to uneven settlement of slab-on-grade foundations. Liquefaction can produce excessive settlement (LandMark 2018, p. 4).

Soil Map Units

Surficial deposits at the Project parcels and surrounding area consist predominantly of silty clay loam, silty clay and clay of the Imperial and Glenbar soil groups.

Table 4.5-3 provides a brief summary of the characteristics of the soil type within the boundaries of the Project parcels, followed by additional details of each soil. Figure 4.5-3 depicts the single soil map unit within the boundaries of the Project parcels.

**TABLE 4.5-3
SUMMARY OF SOIL MAP UNIT WITHIN THE PROJECT PARCELS**

Soil	Texture ¹	Depth of Surface Layer ¹	Wind Erodeability Group ²	Erosion (K) Factor ³	Permeability Inches Per Hour ³
115 Imperial- Glenbar Silty Clay Loams, wet 0 to 2 percent slopes	Loam	0-13	4L	0.37	0.2-0.6

Source: USDA 1981.

¹ Taken from Table 11, Engineering Index Properties.

² Wind erodibility groups range from 1 to 8, with 1 being highly erodible and 8 having low erodibility. Taken from Table 12, Physical and Chemical Properties of Soils.

³ This is an index of erodibility for standard condition and includes susceptibility of soil to erosion and rate of runoff. Low K values (below 0.15) indicate low erosion potential. High K values (above 0.4) are highly erodible. Taken from Table 12, Physical and Chemical Properties of Soils.

115 Imperial-Glenbar Silty Clay Loams, wet, 0 to 2 percent slopes. These nearly level soils are on flood plains and lakebeds within the irrigated areas of the Imperial Valley. Elevation is 35 feet above sea level to 230 feet below (USDA 1981, p. 19). The Imperial soil is very deep and formed in clayey sediment from mixed sources. Permeability of Imperial soil is slow and available water capacity is very high. The Glenbar soil is very deep and formed in alluvium of mixed origin. Permeability of Glenbar soil is moderately slow and available water capacity is very high. These soils are used extensively for homesites and urban areas despite such limitations as high clay content, water table and salinity.

Mineral Resources

Imperial County contains diverse mineral resources. Those with the highest economic value include gold, gypsum, sand, gravel, lime, clay, and stone. Geologic factors restrict mining operations to the relatively few locations where mineral deposits are feasible for extraction. The majority of the mining areas are in the eastern portion of Imperial County as depicted on Figure 5, Mining Resources, of the Imperial County General Plan Conservation and Open Space Element (Imperial County 1993). Two locations where clay, sand and gravel are mined are located in proximity to, but not within, the City of Calexico (City of Calexico 2015a, p. 5-12).

4.5.3 IMPACTS AND MITIGATION MEASURES

A. STANDARDS OF SIGNIFICANCE

The impact analysis provided below is based on the following CEQA Guidelines, as listed in Appendix G. The Project would result in a significant impact to geology and soils if it would result in any of the following:

- a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.
 - ii) Strong Seismic ground shaking.

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Seismic-related ground failure, including liquefaction and seiche/tsunami.

- iii) Landslides.
- b) Result in substantial soil erosion or the loss of topsoil.
- c) Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse.
- d) Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property.
- e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

Note: One additional issue, corrosive soils, was identified in the Preliminary Geotechnical and Geohazards Report and is discussed in the analysis of Project Impacts and Mitigation Measures.

B. ISSUES SCOPED OUT AS PART OF THE INITIAL STUDY

Two criteria were eliminated from further consideration as part of the Initial Study Checklist. Criterion “a-i” was scoped out because the Project parcels are not within a designated State of California Alquist-Priolo Earthquake Fault Zone. In addition, no known active faults have been identified aligning through any of the Project parcels. While fault rupture would most likely occur along established fault traces, fault rupture could occur at other locations. However, the potential for active fault rupture at the Project parcels is considered to be very low.

Criterion “a-iv” was scoped out because the Project parcels are generally flat. Due to the relatively planar topography of the Project parcels, the hazard of landsliding is unlikely. In addition, no ancient landslides are shown on the geologic maps of the region. Lastly, no indications of landslides were observed during the investigation of the Project parcels (LandMark 2018, p. 3).

Criterion “e” was scoped out because the Project will not require construction of a septic system. Both Phase 1 and 2 of the Project will connect to the City’s municipal wastewater system. Therefore, no impact would occur with regard to soil capability to support a septic system and this issue will not be discussed in this section.

C. METHODOLOGY

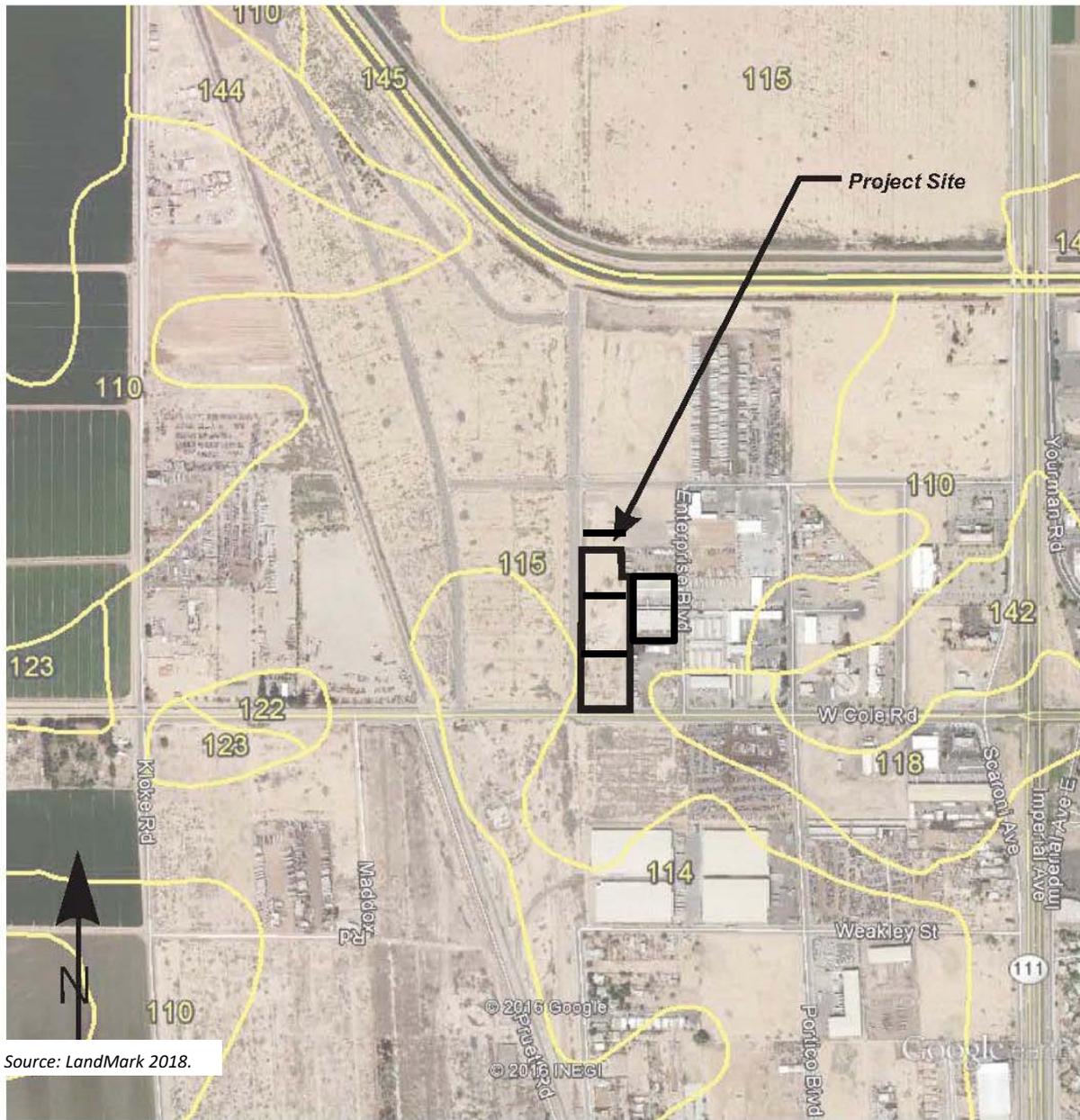
Existing conditions were evaluated based on potential to be affected by construction activities as provided by the Applicant(s). Geology and soils impacts were formulated based on the findings of the “Preliminary Geotechnical and GeoHazards Report, Four Vacant Lots NEC Cole Road and Sunset Blvd, Calexico, California” (LandMark 2018) included in **Appendix E** of the Technical Appendices of this EIR on the attached CD.

D. PROJECT IMPACTS AND MITIGATION MEASURES

Strong Seismic Ground Shaking

Impact 4.5.1 The Project parcels have the potential to be exposed to strong ground shaking during an earthquake along several faults. This is considered a **potentially significant impact**.

The Project area is located in the seismically active Imperial Valley of Southern California. The primary seismic hazard at the Project parcels is the potential for strong groundshaking during an earthquake. The Project parcels would be exposed to groundshaking along the Superstition Hills, Imperial, Cerro Prieto, and Laguna Salada Faults (**Figure 4.5-1**) (LandMark 2018, p. 5).



Source: LandMark 2018.

FIGURE 4.5-3
MAP OF SOIL UNIT ON THE PROJECT PARCELS

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Imperial County is classified as Seismic Zone 4 by the Uniform Building Code (UBC 1997). Developments within in Seismic Zone 4 (highest risk on a scale of 0 to 4) are required to incorporate the most stringent earthquake resistant measures. The Project parcels will likely be subjected to a moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily upon the earthquake magnitude and distance to the seismogenic (rupture) zone. Ground accelerations are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault. The Project parcels have a peak ground acceleration (PGA_M) value (i.e. Ground Acceleration Value) of 0.50 g (LandMark 2018, p. 5). This would result in a severe perceived shaking with moderate to heavy damage. Exposure of the Trinity Cannabis Cultivation and Manufacturing Facility to strong seismic ground shaking is considered a **potentially significant impact**.

Mitigation Measures

MM 4.5.1 Project structures shall be designed and constructed in accordance with the 2016 California Building Code (CBC) for Soil Site Class D (stiff soil profile), ASCE 7-10 Seismic Parameters, and CBC as appropriate.

Timing/Implementation: Prior to approval of final building plans/As part of Project design.

Enforcement/Monitoring: City of Calexico Engineering and Development Services Department.

Significance After Mitigation

Implementation of mitigation measure MM 4.5.1 would reduce potential structural damage caused by strong seismic ground shaking by adhering to and enforcing the appropriate provisions of the 2016 CBC, ASCE 7-10 Seismic Parameters and CBC as appropriate. Thus, strong seismic ground shaking impacts can be mitigated to a **less than significant** level through adherence to applicable codes and standards.

Liquefaction/Seismic Settlement

Impact 4.5.2 Silty clays and clay are the predominant soils on the Project parcels. Liquefaction is a potential design consideration because of possible saturated sandy substrata underlying the Project parcels which could result in seismic settlement. Therefore, liquefaction and seismic settlement are considered a **potentially significant impact**.

Liquefaction is a potential design consideration because of possible saturated sandy substrata underlying the Project parcels. Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases, and the soil behaves as a liquid (similar to quicksand) (LandMark 2018, p. 3).

Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations. Four conditions are generally required for liquefaction to occur:

- 1) the soil must be saturated (relatively shallow groundwater)
- 2) the soil must be loosely packed (low to medium relative density)
- 3) the soil must be relatively cohesionless (not clayey); and
- 4) groundshaking of sufficient intensity must occur to function as a trigger mechanism

All of these conditions may exist to some degree at the Project parcels. However, liquefaction settlement and ground fissures were not noted in the area of the Project parcels after the April 4, 2010 magnitude 7.2 Mw El Mayor-Cucapah Earthquake (LandMark 2018, p. 3). Nevertheless, based on soil conditions and

the Project parcels' location within a seismically active area, liquefaction and seismic settlement are considered a **potentially significant impact**.

Mitigation Measures

Refer to mitigation measure MM 4.5.1

Significance After Mitigation

By adhering to and enforcing the appropriate provisions of the 2016 CBC and ASCE 7-10 Seismic Parameters, mitigation measure MM 4.5.1 would reduce potential damage caused by liquefaction resulting from strong seismic ground shaking. Thus, liquefaction and seismic settlement impacts can be mitigated to a **less than significant** level through adherence to applicable codes and standards.

Erosion

Impact 4.5.3 Surface soils on the Project parcels are generally classified as silty clay and clay. The hazard of erosion on these soils is considered low. Therefore, erosion of site soils is considered a **less than significant impact**.

As described above in **Table 4.5-2**, soils on the Project parcels consist of Imperial-Glenbar silty clay loams, wet 0 to 2 percent slopes. Both the Imperial soil and Glenbar soil are deep with slow permeability and very high available water capacity. Surface runoff is slow and the hazard of erosion is slight (USDA 1981, p. 19).

During construction any potential for dust or erosion would be controlled by watering in accordance with Imperial County Air Pollution Control District (ICAPCD) Rule 801. Further, the Project would also be subject to preparation, review and approval of a grading plan by the City Engineer and compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit (NPDES No. CAS000001) [Note: Erosion as it relates to water quality is discussed in Section 4.8, Hydrology and Water Quality). No erosion is anticipated once the Project is operational as the site would be covered with pavement with the exception of landscape areas. Therefore, erosion impacts are considered **less than significant**.

Mitigation Measures

None required.

Significance After Mitigation

Not applicable.

Expansive Soils

Impact 4.5.4 The near surface soils in the Project parcels are silty clays and clays. These soils have a moderate to high expansion potential. Therefore, expansive soils present a **potentially significant impact**.

Expansive soils are primarily comprised of clay particles. Clay increases in volume when water is absorbed and shrinks when dry. Expansive soils can damage building foundations, concrete flatwork, and asphaltic concrete pavements as a result of swelling forces that reduce soil strength. According to the Imperial County Soil Survey (USDA 1981, p. 106), Imperial soils have a high shrink-swell potential and Glenbar soils have a moderate shrink-swell potential due to the high clay content. Foundations require extra strength to withstand the stresses of shrinking and swelling. Therefore, the presence of expansive soils is considered a **potentially significant impact**.

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Mitigation Measure

MM 4.5.4 A site specific geotechnical investigation shall be prepared for the Project parcels to determine the extent and effect of expansive soils. The proposed buildings shall be designed in accordance with the recommendations of the geotechnical investigation addressing expansive soils.

Timing/Implementation: As a Condition of Project Approval/Prior to Approval of Grading Plans and Issuance of a Grading Permit.

Enforcement/Monitoring: City of Calexico Engineering Department.

Significance After Mitigation

Implementation of mitigation measure MM 4.5.4 would ensure that the Project is designed and constructed to withstand the stresses of shrinking and swelling potentially occurring in association with on-site soils. With implementation of this mitigation measure, impacts resulting from expansive soils would be reduced to **less than significant**.

Soil Corrosivity

Impact 4.5.5 Soils within the which are known to be corrosive. This is considered Project parcels consist of lakebed deposits a **potentially significant impact**.

Corrosion is an electrochemical process where the reaction rate is largely dependent upon the conductivity of the surrounding electrolyte. Corrosive soils can damage concrete foundations and metal infrastructure. The Imperial Valley, including the City of Calexico, is directly underlain by lacustrine (lake bed) deposits. Slabs-on-grade and concrete sidewalks would come in contact with these soils exposing foundations and other concrete building features to corrosion. Therefore, exposure to soil corrosivity is considered a **potentially significant impact**.

Mitigation Measures

MM 4.5.5 To protect against corrosive soils, high cement contents (6 sacks Type V Portland cement) shall be mixed with low water-cement ratios (0.45 water to cement ratio). Additionally, steel post corrosion protection shall be required for metal features that come in contact with soil. The protection shall consist of zinc coatings (galvanizing) or increasing structural sections to compensate for metal loss due to corrosion.

Timing/Implementation: During construction.

Enforcement/Monitoring: City of Calexico Engineering Department.

Significance After Mitigation

Implementation of mitigation measure MM 4.5.5 would ensure that the Project is designed and constructed to protect concrete against corrosion from contact with on-site soils. With implementation of this mitigation measure, impacts resulting from soil corrosivity would be reduced to **less than significant**.

4.5.4 CUMULATIVE SETTING, IMPACTS AND MITIGATION MEASURES

A. CUMULATIVE SETTING

The geographic scope for the cumulative geology and soils setting is the City of Calexico. A list of proposed, approved and reasonably foreseeable projects in the City of Calexico is identified in Table 3.0-1 of Chapter 3.0, Introduction to the Environmental Analysis and Assumptions Used. While the Town Center Industrial Park is immediately to the west of proposed Parcels 1, 2 and 3, in general, geology and soils impacts are site-specific and limited to the boundaries of each individual project rather than cumulative in nature.

B. CUMULATIVE IMPACTS AND MITIGATION MEASURES

Cumulative Geology and Soils Impacts

Impact 4.5.6 Development of the proposed Project, in conjunction with proposed, approved and reasonably foreseeable projects within the City of Calexico would result in continued urbanization of the area by increasing the density of development and exposing more people and structures to geologic and seismic impacts. These impacts are reduced on a project-specific basis through design and engineering. Therefore, cumulative geology and soils impacts are considered **less than cumulatively considerable**.

Impacts associated with geology and soils are based on existing site-specific conditions that are situated within the subsurface materials that underlay the Project parcels. These inherent conditions are an end-result of natural historical events that developed over vast periods of geologic time. Geology and soil-related impacts are generally site-specific and are determined by a particular site's soil characteristics, topography, and proposed land uses. The Project itself does not alter regional geologic conditions or increase geologic risks and hazards to surrounding lands.

Development projects are analyzed on an individual basis and must comply with established requirements of the City, the UBC and CBC as they pertain to protection against known geologic hazards and potential geologic and soil-related impacts. In addition, the City of Calexico requires discretionary development to prepare a geotechnical investigation conducted by a registered geotechnical engineer (City of Calexico 2015a, p. 8-18). Mitigation measures MM 4.5.1, MM 4.5.4 and MM 4.5.5 identified in this section would address groundshaking impacts, liquefaction/seismic settlement impacts and soil corrosivity impacts associated with implementation of the proposed Project. Therefore, the Project would result in a **less than cumulatively considerable contribution** to strong seismic groundshaking, liquefaction/seismic settlement, expansive soils and soil corrosivity. Likewise, the Project's contribution to cumulative geology and soil related impacts (including strong seismic groundshaking, liquefaction/seismic settlement, expansive soils and soil corrosivity) is considered **less than cumulatively considerable**.

Mitigation Measures

Implement mitigation measures MM 4.5.1, MM 4.5.4 and MM 4.5.5.

Significance After Mitigation

Implementation of project-specific mitigation measures would address geology and soils impacts through design in accordance with the UBC, ASCE 7-10 Seismic Parameters and CBC (MM 4.5.1); preparation of a site-specific geotechnical investigation (MM 4.5.4); and use of Type V Portland Cement and zinc coatings (MM 4.5.5). Therefore, following implementation of these mitigation measures, cumulative impacts associated with geology and soils would be **less than cumulatively considerable**.

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