This section discusses the environmental setting, existing conditions, regulatory context, and potential impacts of the project in relation to geology and soils. The information and analysis in this section is based on the *Geotechnical Engineering Investigation* prepared by Krazan & Associates (2010; see **Appendix F**) and the *Geotechnical Evaluation of the Calcite 220KV Substation & Transmission Alignment* prepared by Ninyo & Moore (2017; see **Appendix F**), both peer reviewed by Michael Baker International.

ENVIRONMENTAL SETTING

GEOLOGIC SETTING

The Mojave Desert occupies about 25,000 square miles of southeastern California. It is landlocked, enclosed on the southwest by the San Andreas fault and the Transverse Ranges and on the north and northeast by the Garlock fault, the Tehachapi Mountains, and the Basin and Range Geomorphic Province. The Nevada state line and the Colorado River form the arbitrary eastern boundary, although the province actually extends into southern Nevada and western Arizona. The San Bernardino–Riverside county line is designated as the southern boundary.

The Mojave area contains Proterozoic, Paleozoic, and lower Mesozoic rocks, although Triassic and Jurassic marine sediments are scarce. The marine sediments of that age may have been eroded away, or parts of the Mojave may have been an early Mesozoic upland on which no such sediments were deposited. Jurassic and Cretaceous granitic rocks of the Nevadan orogeny are widespread throughout the region's mountain blocks.

The desert itself is a Cenozoic feature, perhaps formed as early as the Oligocene, presumably from movements related to the San Andreas and Garlock faults and their predecessors. Prior to the development of the Garlock, the Mojave was part of the Basin and Range Province and shares the province's history, possibly through the first part of the Miocene.

Today, the region is dominated by broad alluviated basins that are mostly aggrading surface receiving nonmarine continental deposits from adjacent uplands. The deposits are burying the old topography, which was previously more mountainous. In the late Tertiary, these mountains shed debris to the Pacific, but with the northward slope of the west side of the San Andreas and accompanying elevation of coastal ranges, drainage began entering interior basins.

The highest general elevation of the Mojave Desert approaches 4,000 feet, but most valleys lie between 2,000 and 4,000 feet. A double chain of lower valleys extends northwesterly across the eastern Mojave, one from Soda Lake northwest to Death Valley including Silver and Silurian lake

playas and lying at elevations slightly below 1,000 feet. The other is a broad depression extending southeast from Bristol Lake near Amboy 600 feet through Cadiz and Danby lakes to the Colorado River between Parker and Blythe. Rock-floored pediments are somewhat more extensive in the northeastern Mojave than elsewhere, and the thickness of valley fill is greatest in the Antelope Valley lying between the Garlock and San Andrea faults in the westernmost Mojave.

REGULATORY FRAMEWORK

STATE

CALIFORNIA BUILDING CODE

The State of California establishes minimum standards for building design and construction through the California Building Code (CBC) (California Code of Regulations, Title 24). The CBC is based on the Uniform Building Code, which is used widely throughout the United States (generally adopted on a state-by-state or district-by-district basis) and has been modified for conditions in California. State regulations and engineering standards related to geology, soils, and seismic activity in the Uniform Building Code are reflected in the CBC requirements.

The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition. It also regulates grading activities, including drainage and erosion control.

LOCAL

SAN BERNARDINO COUNTY GENERAL PLAN

The San Bernardino County 2007 General Plan includes policies and programs that are intended to address geology and soils and guide future development in a way that lessens impacts. For instance, the Safety Element addresses issues related to protecting the community from any unreasonable risks associated with seismically induced surface rupture, ground shaking, ground failure, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence, liquefaction, and other seismic hazards identified on seismic hazard maps; other known geologic hazards; flooding; and wildland and urban fires. The following policies and goals that are relevant to geology and soils include:

SAFETY ELEMENT

GOAL S1 The County will minimize the potential risks resulting from exposure of County residents to natural and man-made hazards in the following

priority: loss of life or injury, damage to property, litigation, excessive maintenance and other social ad economic costs.

Policy S1.1 Inform and educate the public of the risks from natural and man-made hazards, methods available for hazard abatement, prevention, mitigation, avoidance, and procedures to follow during emergencies.

Policy S1.2 Continuously integrate data on natural and man-made hazards into adopted land use and overlay maps, policies, and review procedures for land use proposals and enforcement of development standards.

Policy S1.3 Support and expand emergency preparedness and disaster response programs and establish comprehensive procedures for post-disaster planning in affected areas.

GOAL S7 The County will minimize exposure to hazards and structural damage from geologic and seismic conditions.

Policy S7.1 Strive to mitigate the risks from geologic hazards through a combination of engineering, construction, land use, and development standards.

Policy S7.2 Minimize the risk of potential seismic disaster in areas where inadequate structures exist.

Policy S7.3 Coordinate with local, regional, state, federal, and other private agencies to provide adequate protection against seismic hazards to County residents.

Policy S7.4 Designate areas identified by the Alquist-Priolo Earthquake Fault Zoning Act (Public Resource Code, Division 2, Chapter 7.5) on the Hazard Overlay Maps to protect occupants and structures from high level of risk caused by ground rupture during earthquake.

Policy S7.5 Minimize damage cause by liquefaction, which can cause devastating structural damage and a high potential for saturation exists when the groundwater level is within the upper 50 feet of alluvial material.

Policy S7.6 Protect life and property from risks resulting from landslide, especially in San Bernardino and San Gabriel Mountains that have high landslide potential.

SAN BERNARDINO COUNTY EMERGENCY OPERATIONS PLAN

The San Bernardino County Emergency Operations Plan is a comprehensive, single source of guidance and procedures for the County to prepare for and respond to significant or catastrophic natural, environmental, or conflict-related risks that result in situations requiring coordinated response. It further provides guidance regarding management concepts relating to the County's response to and abatement of various emergency situations, identifies organizational structures and relationships, and describes responsibilities and functions necessary to protect life and property. The plan is consistent with the requirements of the Standardized Emergency Management System (SEMS) as defined in Government Code Section 8607(a) and the National Incident Management System (NIMS) as defined by presidential executive orders for managing response to multi-agency and multi-jurisdictional emergencies. As such, the plan is flexible enough to use in all emergencies and will facilitate response and short-term recovery activities. SEMS/NIMS incorporate the use of the Incident Command System, mutual aid, the operational area concept, and multi/interagency coordination.

SAN BERNARDINO COUNTY HAZARD MITIGATION PLAN

The Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) update is a "living document" that should be reviewed, monitored, and updated to reflect changing conditions and new information. As required, the MJHMP must be updated every 5 years to remain in compliance with regulations and federal mitigation grant conditions. The MJHMP includes information regarding hazards being faced by the County, the San Bernardino County Fire Protection District, the San Bernardino County Flood Control District, and those board-governed special districts administered by the San Bernardino County Special Districts Department.

IMPACT ANALYSIS AND MITIGATION MEASURES

Research was conducted through field and laboratory investigations, along with evaluation of previous geotechnical experience from Krazan & Associates of the area.

THRESHOLDS OF SIGNIFICANCE

In accordance with the CEQA Guidelines, the effects of a project are evaluated to determine whether they would result in a significant adverse impact on the environment. An EIR is required to focus on these effects and offer mitigation measures to reduce or avoid any significant impacts that are identified. The criteria used to determine the significance of impacts may vary, depending on the nature of the project. According to Appendix G of the State CEQA Guidelines, the proposed project would have a significant impact related to geology and soils if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  a. 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.
  b. Strong seismic ground shaking.
  c. Seismic-related ground failure, including liquefaction.
  d. Landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soils, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.
- 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.

PROJECT IMPACTS AND MITIGATION

Impacts to geology and soils are analyzed below according to topic. Mitigation measures directly correspond with an identified impact.

RISK OF DEATH INVOLVING RUPTURE OF ALQUIST-PRIOLO FAULT

Impact 3.5-1	**The project would not 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. Impacts would be less than significant.**

The entirety of San Bernardino County is particularly susceptible to strong ground shaking and other geologic hazards. However, the proposed project site is not located within an Alquist-Priolo Earthquake Fault Zone. While the potential for on-site ground rupture cannot be totally discounted (e.g., unmapped faults could conceivably underlie the project corridor), the likelihood of such an occurrence is considered low because of the absence of known faults within or adjacent to the site. The Helendale fault and the Lenwood fault are the nearest mapped faults,

approximately 7 and 8 miles from the project area, respectively. Accordingly, no significant impacts related to seismic ground rupture (and related effects) are anticipated from implementation of the proposed project. Therefore, impacts related to seismic ground rupture would be less than significant.

Mitigation Measures: None required.

Level of Significance: Less than significant.

RISK OF DEATH INVOLVING STRONG SEISMIC GROUND SHAKING

Impact 3.5-2	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking. Impacts would be less than significant.**

The proposed project site is in a seismically active region and is potentially subject to strong ground acceleration from earthquake events along major regional faults. According to the geologic map of California, San Bernardino sheet (California Geological Survey 1967), the continental transform San Andreas fault is approximately 35 miles to the southwest of the proposed project area. The San Andreas fault as a whole is capable of generating significant seismic activity, but it has not been particularly active along the southern segment. The Helendale fault, approximately 7 miles from the project area, is a right-lateral strike-slip fault 56 miles in length, with unknown rupture intervals and probable magnitudes between 6.5 and 7.3. The Lenwood fault is also a right-lateral strike-slip fault, with rupture intervals of 4,000 to 5,000 years and probable magnitudes of 6.5 to 7.4.

The project design would incorporate measures to accommodate projected seismic loading, pursuant to existing guidelines such as the "Greenbook" Standard Specifications for Public Works Construction (2015) and the 2016 California Building Code. Specific measures that may be used for the proposed project include proper fill composition and compaction; anchoring (or other means of for securing applicable structures); and use of appropriate pipeline materials, dimensions, and flexible joints. Based on the incorporation of applicable measures into project design and construction, potential project impacts associated with strong seismic ground shaking would be less than significant. Therefore, the proposed solar and energy storage project and the Calcite Substation project would result in less than significant impacts related to exposing people or structures to seismic ground shaking.

Mitigation Measures: None required.

Level of Significance: Less than significant.

RISK OF DEATH INVOLVING STRONG SEISMIC GROUND SHAKING

Impact 3.5-3	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides. Impacts would be less than significant.**

ORD MOUNTAIN SOLAR ENERGY AND STORAGE PROJECT

According to the UC Davis Soil Resource Laboratory (2018) and the Natural Resources Conservation Service (USDA-NRCS) (2018), five types of soil have been mapped on the proposed solar and energy storage project area: Helendale loamy sand, 0 to 2% slopes; Helendale loamy sand, 2 to 5% slopes; Cajon sand, 0 to 2% slopes; Cajon-Arizo complex, 2 to 15% slopes; and Wasco sandy loam, cool, 0 to 2% slopes. All of the mapped soil types are moderately well drained with high infiltration (RCC 2016) and are suitable for a PV solar development project.

The project site and surrounding lands support relatively flat terrain where landslides have not historically been of concern. Due to the topography of the subject site and its surroundings, the project is not anticipated to expose people or structures to potential adverse effects involving landslides.

Further, project design and construction would incorporate a number of standard measures to address the potential landslides, including similar types of measures from the CBC and Greenbook standards as noted above in Impact 3.5-2. With incorporation of applicable measures into project design and construction, potential project impacts associated with landslides would be less than significant.

CALCITE SUBSTATION

The project site is generally underlain by granular alluvial deposits consisting of dry to moist, loos to very dense, silty sand, clayey sand, and sandy silt with varying amounts of gravel. The deposits have varying degrees of cementation. Weathered granitic bedrock is located from 33 to 49 feet below ground surface. The project site is relatively flat with a gentle slope toward the southeast. Given the soil and topographic conditions, the project-specific geotechnical investigation did not identify potential landslide concerns. Impacts associated with landslides would be less than significant.

Mitigation Measures: None required.

Level of Significance: Less than significant.

RISK OF DEATH INVOLVING SEISMIC-RELATED GROUND FAILURE

Impact 3.5-4 **The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction. Impacts would be less than significant.**

Liquefaction is the phenomenon whereby soils lose shear strength and exhibit fluid-like flow behavior. Loose granular soils are most susceptible to these effects, with liquefaction generally restricted to saturated or near-saturated soils at depths of less than 50 feet. Liquefaction normally occurs in soils such as sand in which the strength is purely friction. However, liquefaction has occurred in soils other than clean sand. Liquefaction occurs under vibratory conditions such as those induced by a seismic event.

ORD MOUNTAIN SOLAR ENERGY AND STORAGE PROJECT

The soils in the project area are well drained and are not susceptible to liquefaction; refer also to Impact 3.5-3 above. The soils encountered on the project site predominantly consist of medium to very dense sandy silts, silty sands, sandy silts with trace clay, and sands. Groundwater was not encountered within the soil boring advanced during subsurface exploration. Available groundwater, as well as Krazan & Associates' experience in the area, indicated that historically groundwater has been located at depths greater than 79 feet in the project site vicinity. Based on Krazan & Associates' (2010) findings, the potential for soil liquefaction on the project site is very low due to the moderate to high corrected standard penetration blow counts and the lack of groundwater. Further, project design and construction would incorporate standard design measures to address potential seismic-related liquefaction and related effects such as settlement and lateral spreading, including similar types of measures from the CBC and Greenbook standards as noted above in Impact 3.5-2. With incorporation of such measures into project design and construction, potential impacts associated with seismic-related liquefaction and settlement would be less than significant.

CALCITE SUBSTATION

The project site is not located in an area mapped as being potentially susceptible to liquefaction. Subsurface investigation and laboratory testing indicated that the project site is generally underlain by relatively dense alluvium and bedrock materials, with a depth to groundwater in excess of 50 feet. Therefore, the project site does not have any characteristics that would support liquefaction. Impacts associated with seismic-related liquefaction and settlement would be less than significant.

Mitigation Measures: None required.

Level of Significance: Less than significant.

Soil Erosion or Loss of Topsoil

Impact 3.5-5	**The project would not result in substantial soil erosion or the loss of topsoil. Impacts would be less than significant.**

General site clearing should include removal of asphaltic concrete; concrete; vegetation and existing utilities; and structures, including foundations, basement walls, and floors; existing stockpiled soil; trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. Site stripping would extend to a minimum depth of 2 to 4 inches or until all organics more than 3 percent by volume are removed, and would only be undertaken for areas where roads, foundations, and trenches would be constructed. Deeper stripping may be required in localized areas. These materials will not be suitable for reuse as engineered fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

As part of the approval process, prior to grading plan approval, the project applicant will be required to comply with San Bernardino County Code Chapter 84.29, Renewable Energy Generation Facilities, which establishes requirements for approval of a commercial solar energy facility. The displacement of soil through cut and fill will be controlled by the 2016 California Building Code relating to grading and excavation, other applicable building regulations, and standard construction techniques. The County requires the submittal of detailed erosion control plans with any grading plans. Furthermore, best management practices (BMPs) shall be implemented at all land disturbance sites. As a result, impacts associated with soil erosion are considered less than significant after compliance with required erosion and runoff control measures are included as part of the approval of a grading plan.

Mitigation Measures: None required.

Level of Significance: Less than significant.

Unstable Geologic Unit or Soil

Impact 3.5-6	**The project would not be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Impacts would be less than significant.**

Project-related excavation activities would extend up to approximately 5 feet (maximum) for trenching. Foundation installation for the project's GSU transformer site (within the on-site switchyard) and energy storage structure is anticipated to require excavations up to approximately 8 feet in depth. Gen-tie foundations will typically extend up to 15 feet in depth,

with a maximum anticipated caisson depth of up to approximately 25 feet for the dead-end structure only, depending upon site conditions and structural load. Installation of posts, including pre-drilling, may extend deeper.

According to the geotechnical report (Krazan & Associates 2010), on-site surface soils consist of 6 to 12 inches of very loose silty sand and silty sand with trace clay and gravel. Approximately 6 to 12 inches of fill material consisting of silty sand, sandy silt, and silty sand with gravel was encountered along the edges of the site. Below the loose surface soils and fill material, approximately 1 to 3 feet of loose to very dense silty sand, silty sand with trace clay, and sandy silt with gravel or sand were encountered. Below 3 to 4 feet, approximately 4 to 12 feet of dense to very dense silty sand, sand, clayey sand, and sandy clayey silt, sandy silt, and sandy gravel were encountered. Below 8 to 16 feet, alternating layers of predominantly very dense silty sand, sandy silt, silty sand/sandy silt, sandy clayey silt, and sand were encountered.

Refer also to Impacts 3.5-3 and 3.5-4 relative to the potential for landslides and/or liquefaction to occur. The project site and surrounding lands consist of relatively flat terrain where landslides have not historically been of geologic concern. Additionally, based on a lack of shallow liquefiable soils on-site, distance of the proposed structures from existing seasonal drainage channels in the area, and a lack of saturated cohesionless sediments of geologic concern, the project site is not anticipated to be subject to lateral spreading hazards. Although not specific to the project site, evidence of subsidence has occurred in parts of the Mojave Desert near Lucerne Valley, El Mirage, Lockhart, and Newberry Springs due to historic extraction of groundwater. Monitoring of such potential effects in the region remains ongoing. However, due to the nature of the proposed land use, the project is not anticipated to contribute to adverse effects related to subsidence. All of the mapped soil types, with exception of the fill material, moderately compressible and/or collapsible upper native soils, appear to be conducive to the development of the proposed solar and energy storage project (Krazan & Associates 2010). The surface soils are disturbed, have low strength characteristics, and are highly compressible when saturated. The proposed project design and construction methods, including recompacting surface soils in the area of structure, would stabilize the surface soils, thereby reducing potential impacts of the mapped soils to a less than significant level.

Based on the described conditions and proposed project design and construction methods, no significant impacts related to geologic instability are anticipated as a result of project implementation.

Additionally, the proposed Calcite Substation project site is also not located in an area mapped as being potentially susceptible to liquefaction (San Bernardino County 2007). According to subsurface exploration and laboratory testing conducted by Ninyo & Moore (2017), the site is generally underlain by relatively dense alluvium and bedrock material and the depth to

groundwater is in excess of 50 feet. Accordingly, liquefaction and liquefaction-related seismic hazards would not be a significant impact. In addition, the relatively flat terrain has not been historically susceptible to instability, landslides, or liquefaction events. Because both the proposed Solar and Energy Storage project and the proposed Calcite Substation project are not likely to have soil instability, the proposed project would have less than significant impacts.

Mitigation Measures: None required.

Level of Significance: Less than significant.

EXPANSIVE SOILS

Impact 3.5-7	**The project would be located on expansive soils, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property. Impacts would be less than significant with mitigation implemented.**

Expansive soil consists of soil that is subject to expansion or contraction (shrink-swell) dur to variations in moisture content. The introduction of water into expansive soils can lead to movement and distress and can adversely affect the structural integrity of facilities, including roads, underground pipelines, and shallow foundations.

ORD MOUNTAIN SOLAR ENERGY AND STORAGE PROJECT

The surface and near-surface soils observed on the site consist of sandy silts, silty sands, relatively clean sands, and clayey sands. The clayey soils are considered to be slightly expansive, which could present a significant geologic hazard to the proposed project. Surficial materials within the proposed project site would be limited predominantly to fill deposits and alluvium. These materials exhibit a low potential for expansion, based on their general lack of significant clay content. Because the connected proposed Calcite Substation project would be located on surface soils with similar characteristics as the proposed solar and energy storage project, there would be a potential for expansion. Mitigation measure **GEO-1** would reduce any impacts from potentially expansive soils to less than significant.

Mitigation Measures:

Ord Mountain Solar Energy and Storage project:

GEO-1 Following demolition, stripping, and fill removal operations, the exposed subgrade in exterior flatwork and pavement areas shall be excavated/scarified to a depth of at least 12 inches, worked until uniform and free from large clods, moisture-conditioned to a minimum of 2 percent above optimum moisture content, and

recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Limits of recompaction shall extend 5 feet beyond structural elements. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during field investigation. The upper 12 inches of soil within proposed slab-on-grade and exterior flatwork areas shall consist of non-expansive or lime-treated engineered fill. The non-expansive fill material shall be a well-graded silty sand or sandy silt soil meeting the requirements for non-expansive fill provided in the Engineered Fill section of the Krazan & Associates (2010) report. A clean sand or very sandy soil is not acceptable for this purpose. A sandy soil will allow the surface water to drain into the expansive clayey soil below, which may result in soil swelling. Imported fill shall be approved by the soils engineer prior to placement.

CALCITE SUBSTATION

Based on testing of project soil samples, the site soils are generally granular and have a low potential for expansion, and thus, are not a design consideration. Impacts associated with expansive soils would be less than significant.

Level of Significance: Less than significant with mitigation.

SEPTIC TANKS

Impact 3.5-8	**The project 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. No impact would occur.**

The site presently consists of predominantly vacant agricultural and pasture land. Several concrete slabs and water troughs are located throughout the site. In addition, several structures are located in the project site vicinity. Associated with these developments may be buried structures that extend into the project site. Demolition activities would include the proper removal of any remaining buried structures and the resulting excavations backfilled with engineered fill. Disturbed areas caused by demolition activities should be removed and/or recompacted. Excavations, depressions, or soft and pliant areas extending below planned finish subgrade level would be cleaned to firm undisturbed soil and backfilled with engineered fill. In general, any septic tanks, debris pits, cesspools, or similar structures would be entirely removed.

Furthermore, the proposed project would be unmanned and does not propose to use septic tanks or alternative wastewater disposal systems. Therefore, neither the proposed solar and energy

storage project nor the Calcite Substation project would result in impacts to wastewater. No impacts would result from the proposed project.

Mitigation Measures: None required.

Level of Significance: No Impact.

CUMULATIVE IMPACTS

Impact 3.5-9	**The project would not result in cumulative impacts related to geology and soils. Impacts would be less than significant.**

Geotechnical impacts are site-specific rather than cumulative in nature. For example, seismic events may damage or destroy a structure on the project site, but the construction of a development project on one site would not cause any adjacent parcels to become more susceptible to seismic events, nor can a project affect local geology in such a manner as to increase risks regionally. Soils associated with the project site are similar to other soils in the area. The proposed project will involve minor grading. With compliance with existing codes and standards, including the California Building Code and implementation of mitigation measure GEO-1, the proposed project's contribution to cumulative impacts related to area geological conditions would be less than cumulatively considerable.

Mitigation Measures: None required.

Level of Significance: Less than significant.

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