DOCKETED	
Docket Number:	21-AFC-02
Project Title:	Gem Energy Storage Center
TN #:	240751-10
Document Title:	Section 5_4_Geological Hazards and Resources_Gem Energy Storage Center
Description:	This section provides an evaluation of the proposed Advanced Compressed Air Energy Storage (A-CAES) facility at the Gem Energy Storage Center (GESC) in terms of potential exposure to geological hazards and potential to affect geologic resources of commercial, recreational, or scientific value. The information presented in the following sections is based on readily available information provided online and is limited to surficial soils only. Construction of the proposed GESC involves the construction of various surface facilities and features (i.e., buildings, air processing facility, compressors, turbines, etc.), the excavation of deep vertical shafts on the order of 2,000 feet deep below the existing ground surface, the excavation of an underground cavern, and the construction and filling of a hydrostatic compensation surface reservoir. A site-specific geotechnical exploration has not been performed at the proposed project location to characterize the site-specific surface and subsurface conditions.
Filer:	Kari Miller
Organization:	Golder Associates USA Inc.
Submitter Role:	Applicant Representative
Submission Date:	12/1/2021 3:07:04 PM
Docketed Date:	12/1/2021

5.4 Geological Hazards and Resources

This section provides an evaluation of the proposed Advanced Compressed Air Energy Storage (A-CAES) facility at the Gem Energy Storage Center (GESC) in terms of potential exposure to geological hazards and potential to affect geologic resources of commercial, recreational, or scientific value. The information presented in the following sections is based on readily available information provided online and is limited to surficial soils only. Construction of the proposed GESC involves the construction of various surface facilities and features (i.e., buildings, air processing facility, compressors, turbines, etc.), the excavation of deep vertical shafts on the order of 2,000 feet deep below the existing ground surface, the excavation of an underground cavern, and the construction and filling of a hydrostatic compensation surface reservoir. A site-specific geotechnical exploration has not been performed at the proposed project location to characterize the site-specific surface and subsurface conditions.

5.4.1 Affected Environment

The proposed GESC facility is located on the western limits of Rosamond in Kern County, California. The land surrounding the project site consists of undeveloped, developed with single-family residences, or designated for agricultural purposes. The site is bordered to the west by Tehachapi Willow Springs Rd, and Hamilton Rd runs adjacent to the northern edge. Willow Springs Butte is located just south of the site. Residences are located to the southwest and northeast of the project site adjacent to the project boundary.

5.4.1.1 Regional Geology

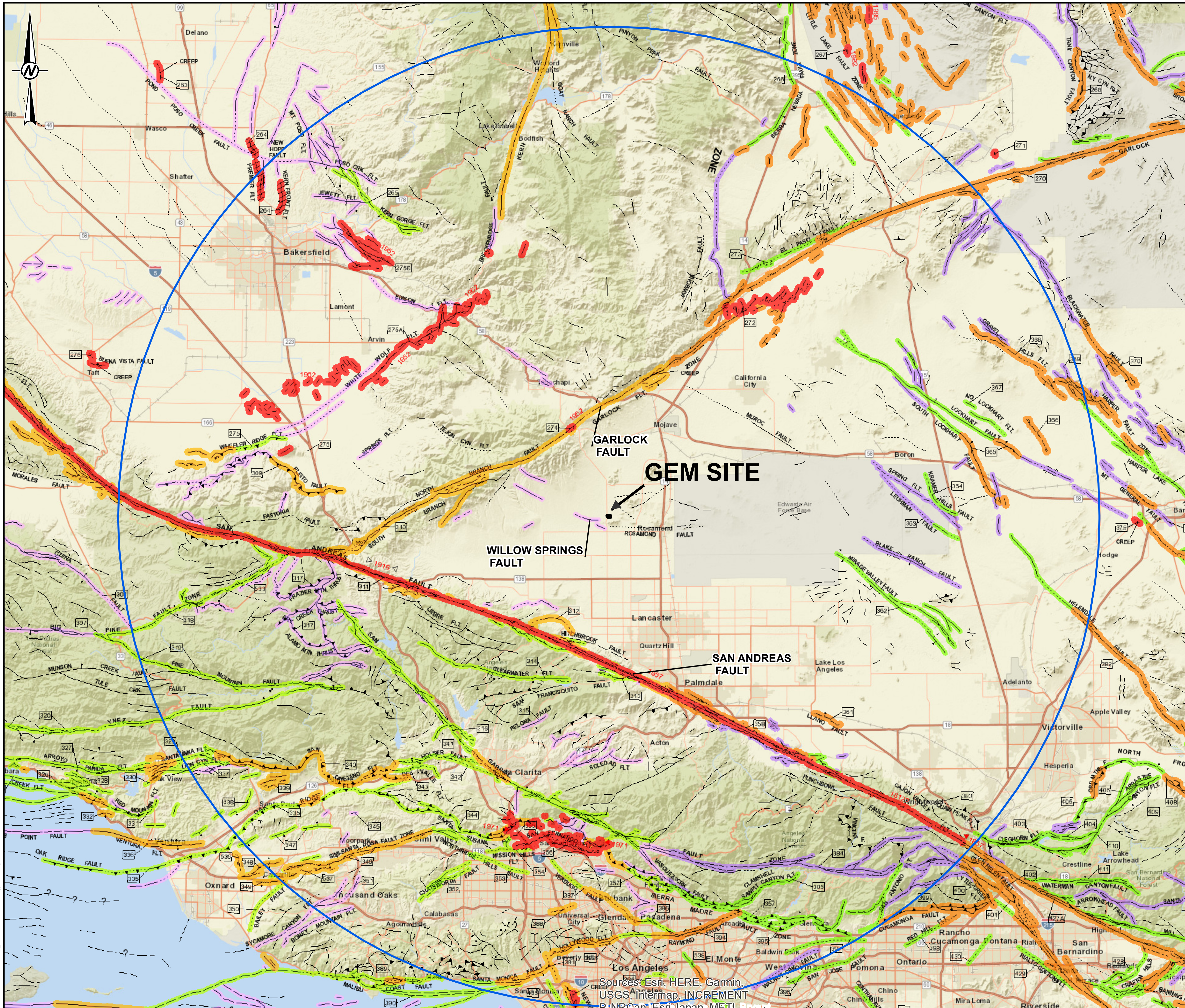
The proposed project site is located within the Mojave Desert geomorphic province of California (California Geological Survey (CGS) 2002). The Mojave Desert province is a broad region of isolated mountain ranges that are separated by desert plains. The western edge of this geomorphic province is wedged between the Garlock Fault and the San Andreas Fault. The proposed site is located within the Willow Springs 7.5-minute Quadrangle within the Antelope Valley Basin. The Antelope Valley is covered mainly by alluvium and windblown sands of the Quaternary Period. The alluvial deposits within the valley are underlain mostly by a quartz monzonite bedrock (U.S. Geological Service (USGS) 1953).

5.4.1.1.1 Faulting and Seismicity

The CGS Fault Activity Map web application was used to identify major fault zones, such as the San Andreas and Garlock Faults, within 62 miles of the site (CGS 2016). The State of California defines an active fault as one that has ruptured in the last 11,700 years. Potentially active faults are those with evidence of movement within the last 1.8 million years.

The active Garlock fault is approximately 11.5 miles northwest of the proposed project site. The active San Andreas Fault Zone is approximately 17 miles southwest of the proposed project site. Both of these faults are very active and have generated major earthquakes. Additionally, the potentially active Willow Springs Fault is approximately 4,000 feet southwest and west of the proposed project site. Figure 5.4-1 shows the faults identified within a 62-mile radius of the proposed A-CAES facility.

The CGS Data Viewer application was also used to determine the epicenter locations of historic earthquakes around California (CGS 2017b). The program shows known magnitude 5.0 or greater earthquakes occurring from 1769 through 2015. The closest identified earthquake to the site had a magnitude of 5.0 to 6.0 and occurred approximately 12 miles to the southwest. Two earthquakes with magnitude 7.0 or higher have occurred within 62 miles of the site at the Pleito Hills and Mount San Antonio fault zones.



LEGEND

- GEM SITE
- 62 MILES RADIUS

Fault Classification (State)

Activity

- Historic
- Holocene
- Late Quaternary
- Quaternary

Pre-Quaternary Faults

- <all other values>
- fault, certain
- fault, approx. located
- fault, concealed
- thrust fault, certain
- thrust fault, approx. located
- thrust fault, approx. located, queried
- fault, certain (ball and bar)
- fault, approx. located (ball and bar)
- fault, concealed (ball and bar)

Quaternary Faults

- fault, certain
- fault, approx. located
- fault, approx. located, queried
- fault, inferred, queried
- fault, concealed
- fault, concealed, queried
- thrust fault, certain
- thrust fault, approx. located
- thrust fault, concealed
- dextral fault, certain
- dextral fault, approx. located
- dextral fault, concealed
- sinistral fault, certain
- sinistral fault, approx. located
- sinistral fault, concealed
- thrust fault, certain (2)
- thrust fault, approx. located (2)
- thrust fault, concealed (2)
- fault, certain (ball and bar)
- fault, approx. located (ball and bar)
- fault, concealed (ball and bar)
- dextral fault, certain (ball and bar)
- fault, concealed, queried (ball and bar)
- fault, concealed, queried (ball and bar, 2)
- fault,certain (dip)
- fault, approx. located (dip)
- fault, concealed (dip)
- reverse fault, certain
- reverse fault, approx. located
- reverse fault, concealed

NOTES

SOURCE DATA: HTTPS://MAPS.CONSERVATION.CA.GOV/

0 10 20 Miles

1:783,000

REFERENCE

COORDINATE SYSTEM: NAD 1983 STATEPLANE CALIFORNIA V FIPS 0405 FEET

CLIENT
HYDROSTOR INC.

PROJECT
GEM ENERGY STORAGE CENTER

TITLE
FAULT MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-08-16
PREPARED	MR
DESIGN	MR
REVIEW	JB
APPROVED	RPCE

PROJECT No.	CONTROL	Rev.	FIGURE
20449449	---	---	5.4-1

5.4.1.2 Local Geology and Stratigraphy

According to the Geologic Map and Sections of the Willow Springs and Rosamond Quadrangles, California map, alluvial deposits surround the base of Willow Springs Butte and cover the extent of the proposed GESC site. The alluvium generally consists of lake, playa, and terrace deposits, and are unconsolidated to semi-consolidated. The Willow Springs Butte directly to the south and uphill of the site consists of Tertiary aged sedimentary and metamorphic material. This unit includes sandstones, shales, conglomerates, breccias, and ancient lake deposits. Figure 5.4-2 includes a geologic map of the site and surrounding area.

5.4.1.3 Seismic Setting

The tectonic setting of Southern California is complex and is made up of numerous fault systems, including strike-slip, oblique, thrust, and blind thrust faults. Therefore, any specific area is subject to seismic hazards of varying degrees, dependent on the proximity to and the length of nearby active, potentially active faults, and the local geologic and topographic conditions. Seismic hazards include primary hazards such as seismic shaking and ground rupture along the fault trace, and secondary hazards resulting from strong ground shaking such as liquefaction and lateral spreading. The proposed A-CAES site area can be characterized as an active seismic area, with the potential for large-magnitude earthquakes to occur.

5.4.1.4 Potential Geologic Hazards

The following subsections present the potential geological hazards that may occur within the project area.

5.4.1.4.1 Ground Rupture

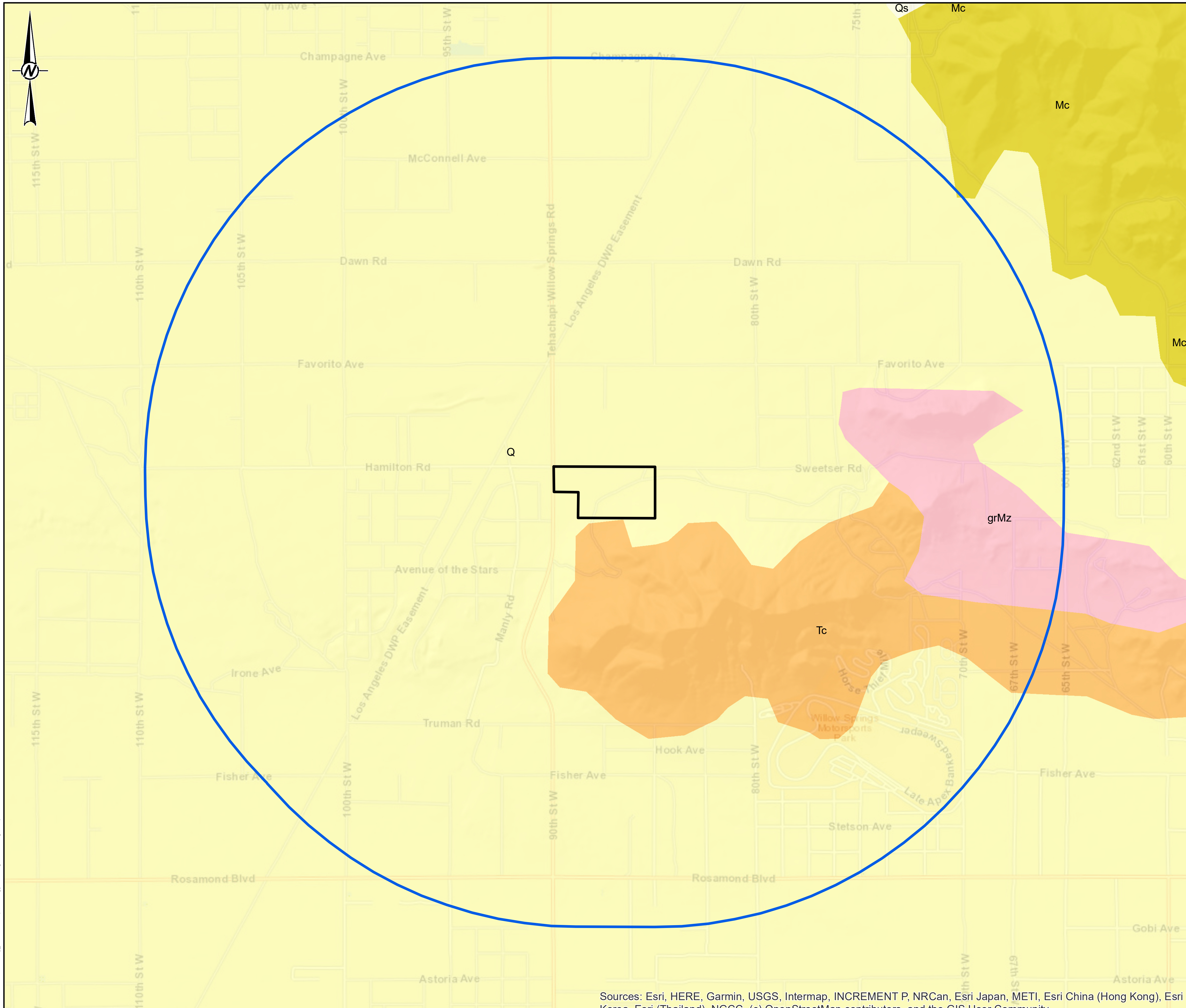
The CGS Seismic Hazards Program web application was used to determine the site’s proximity to any known Alquist-Priolo earthquake zones (CGS 2017a). Alquist-Priolo fault zones are regulatory zones that encompass the minimum distance for human occupancy from active faults that have the potential for surface rupture. No structures designed for human occupancy can be placed over the fault or within 50 feet in any direction. According to the CGS Fault Activity Map, the site is not bisected by any known active or potentially active faults and the web application shows that the site is spaced approximately 12 miles northeast from the nearest Alquist-Priolo fault zone, which is associated with the Lake Hughes fault zone.

The likelihood for a ground rupture to occur at the proposed GESC site is considered low and its corresponding impacts are less than significant.

5.4.1.4.2 Seismic Shaking

Due to the site’s proximity to surrounding fault zones, the site may experience strong ground motions in the event of an earthquake. The CGS Earthquake Shaking Potential Map web application categorizes areas based on their expected intermediate period ground motions with a 2 percent exceedance probability in 50 years (CGS 2017c). This application incorporates anticipated amplification of ground motions by local soil conditions and places the earthquake shaking potentials in a qualitative ranking system from highest to lowest potential. The GESC project site is ranked by the web application as having medium shaking potential.

Site-specific hazard analyses (SHA) have not been performed for the site. However, a cursory assessment using the USGS Unified Hazard Tool (USGS 2014), assuming a 2475 return period and Site Class B (rock) conditions, indicates a peak ground acceleration (PGA) of 0.44g (where g represents acceleration due to gravity) and mean earthquake magnitude of 7.18.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

LEGEND

- GEM SITE
- 2 MILE RADIUS
- QS - EXTENSIVE MARINE AND NONMARINE SAND DEPOSITS, GENERALLY NEAR THE COAST OR DESERT PLAYAS.
- Q - ALLUVIUM, LAKE, PLAYA, AND TERRACE DEPOSITS; UNCONSOLIDATED AND SEMI-CONSOLIDATED. MOSTLY NONMARINE, BUT INCLUDES MARINE DEPOSITS NEAR THE COAST.
- TC -UNDIVIDED TERTIARY SANDSTONE, SHALE, CONGLOMERATE, BRECCIA, AND ANCIENT LAKE DEPOSITS.
- MC - SANDSTONE, SHALE, CONGLOMERATE, AND FANGLOMERATE; MODERATELY TO WELL CONSOLIDATED.
- TVP - TERTIARY PYROCLASTIC AND VOLCANIC MUDFLOW DEPOSITS.
- GRMZ -MESOZOIC GRANITE, QUARTZ MONZONITE, GRANODIORITE, AND QUARTZ DIORITE.

NOTES

SOURCE DATA: HTTPS://MAPS.CONSERVATION.CA.GOV/

1:30,240

0 — 1 Miles

REFERENCE

COORDINATE SYSTEM: NAD 1983 STATEPLANE CALIFORNIA V FIPS 0405 FEET

CLIENT
HYDROSTOR INC.

PROJECT
GEM ENERGY STORAGE CENTER

TITLE
GEOLOGIC MAP

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-08-13
PREPARED	MR
DESIGN	MR
REVIEW	JB
APPROVED	RPCE

PROJECT No.	CONTROL	Rev.	FIGURE
20449449	---	---	5.4-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

A site-specific probabilistic and deterministic seismic hazard analysis for the proposed project site will be completed to determine the magnitude and duration of seismic shaking and related impacts. Seismic shaking impacts can be mitigated to less than significant if an appropriate SHA is conducted, and the site facilities are designed to withstand seismic ground motions in compliance with applicable seismic design codes (i.e., Section 1613 of the California Building Code, Chapter 20 of the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures (ASCE 2016)).

Furthermore, advancement of the project is contingent on sound bedrock that is seismically stable at the depth of the underground cavern.

5.4.1.4.3 Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of a typically loose, cohesionless (i.e., sand), saturated soil is reduced by earthquake shaking or other rapid loadings. Soil maps from the Natural Resource Conservation Service (NRCS) identify two surficial soil units within the proposed project site, the Arizo and DeStazo soils (NRCS 2021). Section 5.11, Soils, describes these in greater detail but, to summarize, the Arizo soil is dominated by gravels and cobbles, whereas the DeStazo soil is dominated by sand. Based on the available information provided by NRCS, the Arizo soil is likely not susceptible to liquefaction given its gravel and cobble content, which typically do not liquefy, whereas the DeStazo soil may be susceptible to liquefaction. However, the NRCS data is very limited and cannot be solely relied on to determine liquefaction susceptibility.

Liquefaction is also a function of the presence of groundwater. As described in Section 5.11.1.5.2, groundwater at the proposed GESC site is likely at least 100 feet below the existing ground. Liquefaction generally occurs in the upper 100 feet of soil. If groundwater is deeper than 100 feet, the possible impacts imposed by liquefaction are less than significant.

The California Geological Service (CGS) Seismic Hazards Program: Liquefaction Zones map (CGS 2017) was reviewed and shows that mapping has not been performed within the proposed GESC project limits. This does not preclude the possibility of liquefaction potential within the proposed project limits.

At the time this was prepared, there was not any site-specific subsurface information available to evaluate the likelihood and risk of liquefaction to occur at greater depths, which may impact the construction and operation of the proposed GESC. The potential impacts and geologic hazards associated with liquefaction can be mitigated to less than significant by performing a site-specific geotechnical exploration and implementing recommendations to mitigate liquefaction, if applicable.

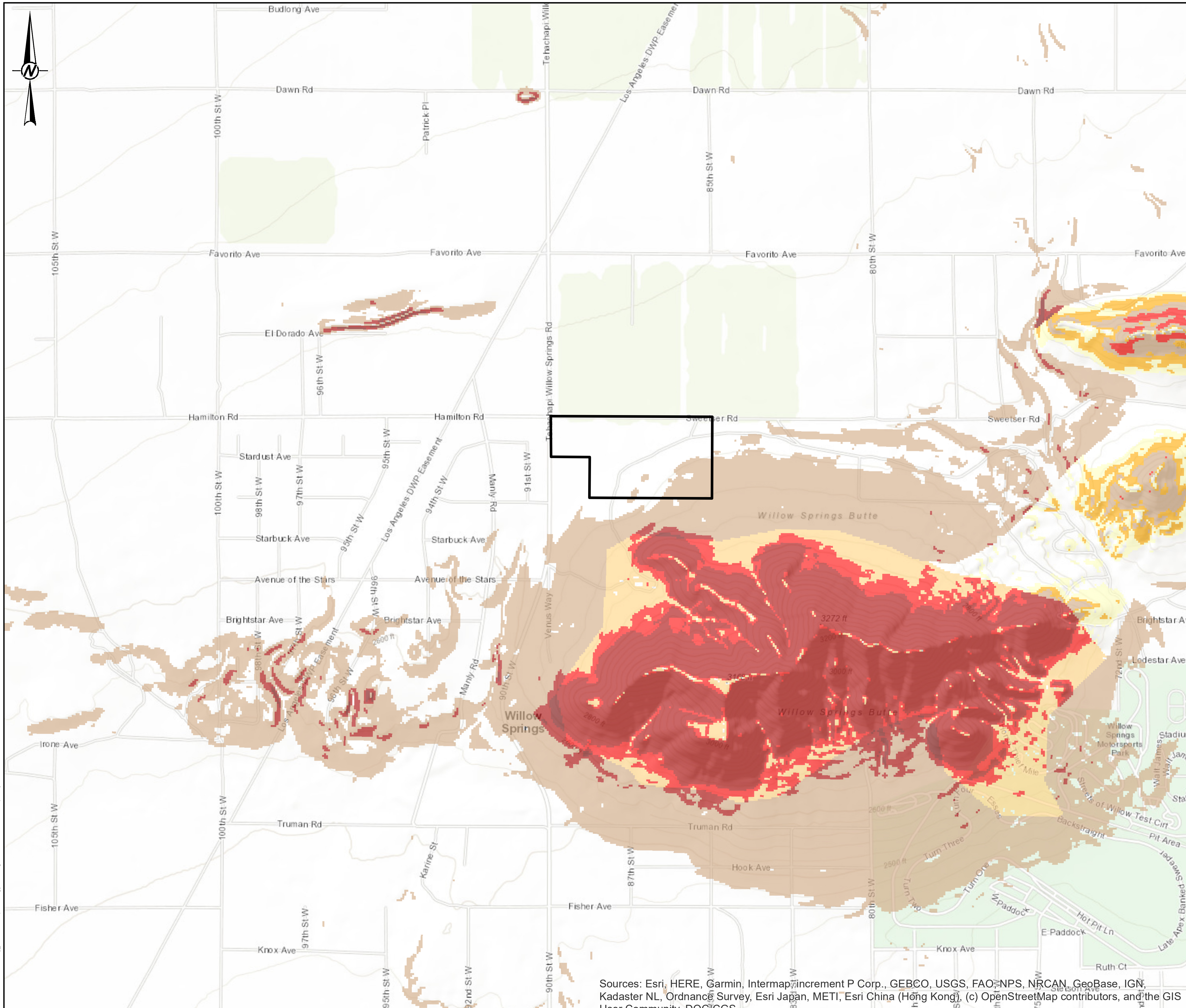
As stated in Section 5.4.1.4.3, advancement of the project is contingent on sound bedrock that is seismically stable at the depth of the underground cavern. Therefore, the potential impacts and geologic hazards associated with liquefaction are applicable to the surficial structures, but not applicable to the underground cavern.

5.4.1.4.4 Mass Wasting

The potential for mass wasting (landsliding) to occur depends on a variety of factors including, but not limited to, the steepness of the slope, geology, and soil moisture.

The CGS Deep-Seated Landslide Susceptibility Map web application estimates an area’s susceptibility to mass wasting events based on the location of past landslides, the location and relative strength of rock units, and steepness of surrounding slopes (CGS 2018). Landslide susceptibility is characterized by the use of classes, zero (0) through ten (X), class X having the highest landslide potential. A vast majority of the site is relatively flat and defined as class 0, except for the southeastern corner of the proposed project limits at the base of Willow Springs

Butte which is categorized as class VII. This indicates a negligible to moderate susceptibility to the propagation of landslides from within the site boundary. Potential impacts related to mass wasting can be mitigated by completing site-specific geotechnical exploration and implementing geotechnical recommendations. Figure 5.4-3 shows the CGS Deep-Seated Landslide Susceptibility at the proposed GESC location.



LEGEND

GEM SITE

CLASS

- 0
- III
- V
- VI
- VII
- VIII
- IX
- X

NOTES

SOURCE DATA: HTTPS://MAPS.CONSERVATION.CA.GOV/

1:19,000

0 — 1 Miles

REFERENCE

COORDINATE SYSTEM: NAD 1983 STATEPLANE CALIFORNIA V FIPS 0405 FEET

CLIENT
HYDROSTOR INC.

PROJECT
GEM ENERGY STORAGE CENTER

TITLE
LANDSLIDE SUSCEPTIBILITY MAP

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-08-17
PREPARED	MR
DESIGN	MR
REVIEW	JB
APPROVED	RPCE

PROJECT No.	CONTROL	Rev.	FIGURE
20449449	---	---	5-4-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

Path: G:\GIS\Sites\MoroBay_Rosamond\Maps\Geology\GEM\Figure5-4-3-Landslide Susceptibility.mxd

5.4.1.4.5 Subsidence

Subsidence occurs as the gradual settling of the ground surface over time due to underground material movement. Subsidence is most often caused by the removal of groundwater through pumping activities, fracking activities for oil extraction, or the mining of other mineral resources. Soil compaction, sinkhole formation, and earthquakes can also cause subsidence to occur.

Construction of the proposed GESC will involve filling the hydrostatic compensation surface reservoir using a combination of onsite groundwater production and water purchased from Antelope Valley East Kern Water Agency. Operation of the GESC will involve using an onsite groundwater well to control the reservoir level. Groundwater withdrawal typically causes uniform subsidence, which is less problematic than differential subsidence. The thickness of the basin sediments likely varies within the proposed project footprint and would subsequently play a role in the subsidence that is expected to occur. A site-specific geotechnical exploration will verify subsurface conditions at the proposed project site and, if necessary, control measures will be implemented to control groundwater drawdown to reduce the potential for subsidence at the project site to less than significant. Section 5.15, Water Resources provides further information on water sourcing and subsidence history in the Antelope Valley Basin.

5.4.1.4.6 Expansive Soils

Expansive soils have the potential to shrink and swell with variations in saturation, which could cause ground instability in the form of differential settlement.

Information gathered from the NRCS Web Soil Survey, cross-referenced with the NRCS Soil Texture Triangle, suggests that the Arizo series soils are dominated by gravels and cobbles, but possibly contain up to 20 percent clay. Due to the expected presence of gravels, the Arizo series likely has a low shrink-swell potential. The DeStazo series, however, appears to be dominated by clayey loam and may have at least a low shrink-swell potential. Actual expansive soil susceptibility will depend on the actual characteristics of the materials on site. For the proposed GESC and its features, the presence of expansive soils would only be a possible concern to buildings and foundations. A site-specific geotechnical exploration has not been conducted to confirm the presence of expansive soils. Section 5.11, Soils, discusses additional information on expansive soils. The possible presence of expansive soils can be mitigated to less than significant through the use of soil amendments or by removal and replacement with non-expansive soils, or by designing buildings and foundations to withstand the expansive soil.

5.4.1.4.7 Tsunamis and Seiches

Tsunamis are large ocean waves that are seismically induced and often the result of offshore earthquakes or landslides. The proposed site is over 60 miles from the coastline, and therefore the potential for the site to be affected by a Tsunami is negligible.

Seiches are waves and oscillations within confined bodies of water that are seismically induced by ground shaking. There are no large, confined bodies of water immediately adjacent to or uphill of the site, and therefore the potential for an off-site seiche to impact the project site is negligible. The planned compensation reservoir for site operations will be designed to be seismically stable and with adequate freeboard to mitigate overtopping and loss of containment, including from possible seiches. Section 5.15, Water Resources provides further information regarding the on-site compensation reservoir.

5.4.1.4.8 Permanent Slopes and Embankments

Construction of the proposed GESC includes permanent embankments for the hydrostatic compensation surface reservoir. The embankment, and any other permanent slopes, will be analyzed for slope stability and designed to achieve appropriate minimum factors of safety for both static and seismic conditions. Additionally, the hydrostatic compensation surface reservoir may be considered a jurisdictional dam, which would be regulated by the Division of Safety of Dams (DSOD) during its construction and operation. Refer to Section 5.15, Water Resources, for additional information on the compensation reservoir and DSOD requirements.

5.4.1.4.9 Collapse of Below Grade Features

Construction of the proposed GESC includes the excavation of deep vertical shafts and an underground cavern. The collapse of either, or both, of these below grade features may result in surface settlement and subsidence. The potential impacts related to the possible collapse of these features may not be significant depending on their design (i.e., depths, extents, etc.) and the site-specific subsurface conditions present at the proposed project site. However, if necessary, potential impacts can be mitigated to less than significant by completing a site-specific geotechnical exploration and properly designing and constructing (i.e., rock bolts, lined shaft, etc.) as warranted based on the subsurface conditions.

Additionally, below grade features will be properly closed, as described in Section 2.0, Project Description.

5.4.1.4.10 Anthropologically Induced Seismicity

It is possible for anthropologically induced seismicity to occur when manmade activities impose additional strain on underlying rock masses below the existing ground surface, in particular along active faults. Possible triggering mechanisms of this phenomenon for the proposed GESC are reservoir induced seismicity (RIS) and compressed air at depth.

5.4.1.4.10.1 Reservoir Induced Seismicity

RIS can be triggered by rising water levels through one of the two following mechanisms (Dojchinovski 2012):

- The adaptation of the foundation rock to changes in stress due to the weight of water
- Reservoir seepage that reaches active faults located underneath or adjacent to the reservoir

Potential impacts associated with the first mechanism, if any depending on the site-specific subsurface conditions (i.e., if cavities, voids, or potentially open discontinuities are present), can be mitigated to less than significant. This mechanism tends to result in small magnitude events that would be less than the design earthquake that is selected per the outcome of the seismic hazard analysis and used for the design of the GESC.

Potential impacts associated with the second mechanism are considered less than significant because all four of the following conditions must exist for this to be a concern:

- The reservoir needs to be deep to very deep, defined as 263 to greater than 492 feet (USGS, 1996)
- Seismogenic structures (i.e., faults) are present in or near the reservoir
- The seismogenic structure is active and therefore is likely close to the failure point prior to filling the reservoir
- The existence of hydrological conditions for infiltration of water from the reservoir to deep layers of the rock mass

At a minimum, the proposed reservoir is shallow (less than 50 feet deep) and there are no known active seismogenic structures near the project site.

5.4.1.4.10.2 Compressed Air Induced Seismicity

Potential impacts related to compressed air or water induced seismicity would be considered credible if the vertical shafts and/or underground cavern intersected an active fault. Because there are no known active faults near the proposed project site, the potential impacts are considered to be less than significant.

Hydraulic fracturing rock for oil and gas exploration, and deep wastewater injection wells, have occasionally caused seismic events. These types of projects differ fundamentally from the GESC project in that they intentionally fracture rock under pressures of 9,000 psi or more and/or involve the permanent disposal of significant volumes of liquids. In contrast, the successful performance of the GESC project depends on the surrounding rock remaining intact during operation (i.e., not fracturing) in order to retain air and water, which will be addressed during the design of the project. In addition, operating pressures for the GESC project are expected to be 1,000 psi or less, which are considerably lower than that for hydraulic fracturing and most deep injection wells.

5.4.1.5 Geologic Resources of Recreational, Commercial, or Scientific Value

The geology in the proposed site vicinity mostly includes alluvial deposits with igneous intrusions. These deposits are not unique in terms of recreational or scientific value, and they occur throughout the Antelope Valley. The California Department of Conservation (CDOC) Division of Mines and Geology published two mineral land classification maps for the Willow Springs Quadrangle in 1999 (CDOC 1999). The mineral land classification maps evaluate areas based on the presence of both gold and silica-containing limestone deposits. The project location is in an area of no known mineral occurrences where geologic information does not rule out either the presence or absence of significant mineral resources. The eastern half of the Willow Springs Butte is identified as MRZ-3, signifying that the area contains either known or inferred gold occurrence, but the mineral resource significance is undetermined. These designated areas are located well outside of the proposed GESC boundary, therefore potential impacts to geologic resources of recreational, commercial, or scientific value are less than significant. Mineral Land Classification maps are included as Figures 5.4-4 and 5.4-5.

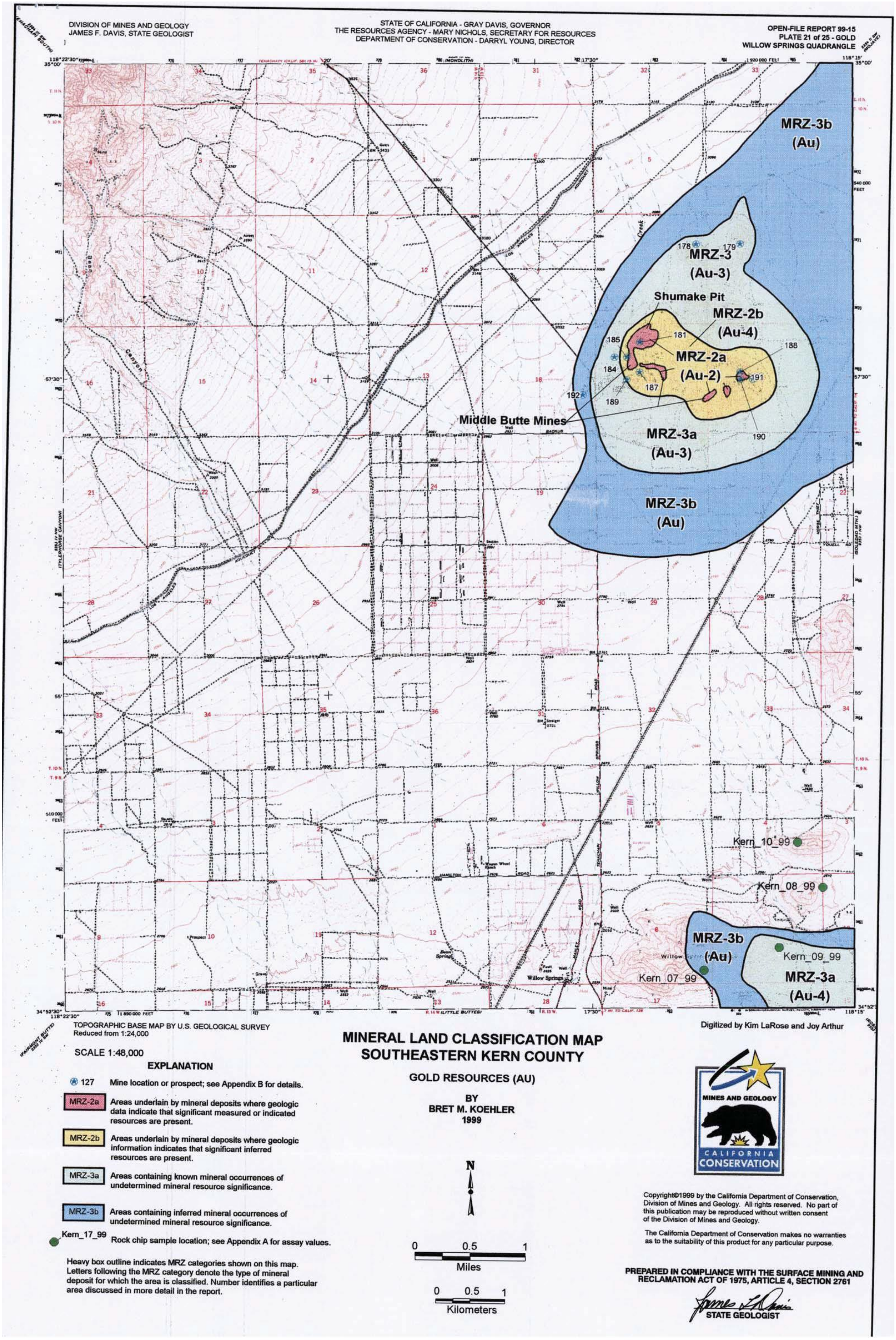


Figure 5.4-4 Mineral Land Classification Map – Gold Resources
Gem Energy Storage Center

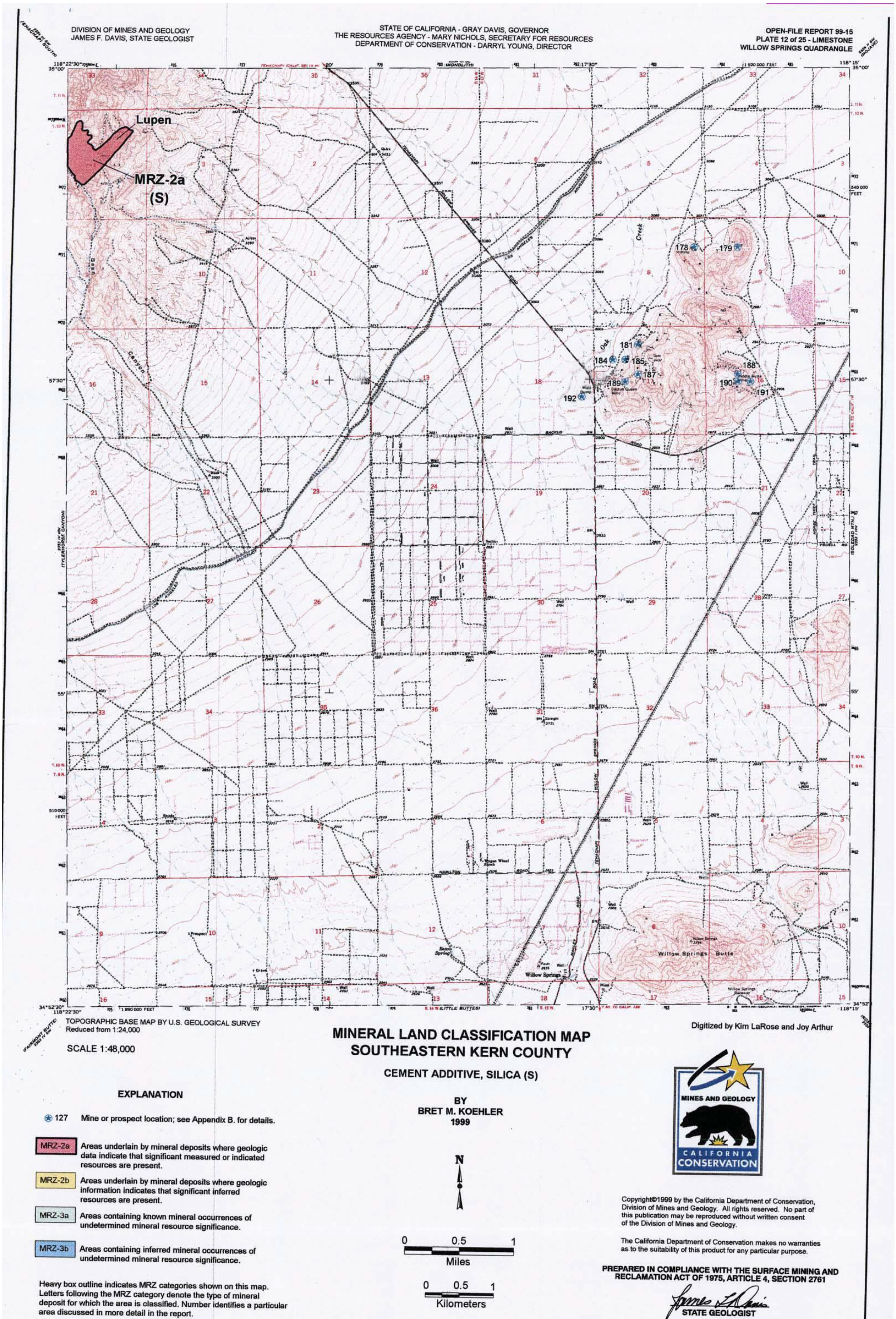


Figure 5-4-5 Mineral Land Classification Map – Cement Additive, Silica

5.4.2 Environmental Analysis

The following sections present the potential effects from the construction and operation of the proposed GESC on geologic resources and risks to life and property from geologic hazards.

5.4.2.1 Significance Criteria

According to Appendix G of the California Environmental Quality Act statutes, a project would have a significant environmental impact in terms of geological hazards and resources if it would do the following:

- Directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving the following:
  - 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
  - Landslides
- 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 offsite landslide, subsidence, liquefaction, or collapse.
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan.

5.4.2.2 Geological Hazards

As described in Section 5.4.1.4, the following potential geological hazards, with corresponding impact assessment, have been identified. Mitigation measures to reduce the impact(s) to less than significant are described in Section 5.4.4.

- Ground Rupture related impacts are considered less than significant.
- Seismic Shaking related impacts can be mitigated to less than significant.
- Liquefaction related impacts can be mitigated to less than significant.
- Mass Wasting related impacts can be mitigated to less than significant.
- Subsidence related impacts can be mitigated to less than significant.
- Expansive Soils related impacts can be mitigated to less than significant.
- Tsunamis and Seiches related impacts are less than significant.
- Permanent Slopes and Embankments related impacts can be mitigated to less than significant.

- Collapse of below grade features related impacts can be mitigated to less than significant.
- Reservoir induced seismicity related impacts can be mitigated to less than significant.
- Compressed air induced seismicity related impacts are less than significant.

5.4.2.3 Geological Resources

The proposed GESC facility will not result in a loss of availability of any known valuable mineral resources. Additionally, the GESC will not result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan.

5.4.3 Cumulative Effects

A cumulative impact refers to a proposed project's incremental effect together with other closely related past, present, and reasonably foreseeable future projects whose impacts may compound or increase the incremental effect of the GESC (Public Resources Code Section 21083; CCR, Title 14, Sections 15064[h], 15065[c], 15130, and 15355).

The impacts of the proposed GESC project are expected to be less than or mitigated to less than, significant. However, we do not have any information on or knowledge of other projects within the vicinity of the proposed GESC project and, therefore, do not have a basis to evaluate the cumulative effects of the proposed project.

5.4.4 Mitigation Measures

The following mitigation measures will reduce potential impacts related to geological hazards to less than significant during construction and operation of the proposed GESC:

- Perform a site-specific geotechnical exploration to collect geotechnical data to:
  - Confirm surface and subsurface soil and rock types and characteristics
  - Measure the depth to groundwater
  - Determine Site Class for use in seismic hazard analyses
  - Evaluate liquefaction susceptibility and potential, and calculate corresponding liquefaction induced settlement if applicable
  - Determine if expansive soils are present
  - Evaluate potential subsidence impacts associated with groundwater pumping
  - Support the design of the foundations and below grade features
- Verify the recommendations provided in the geotechnical report are followed during the construction and operation of the proposed GESC
- Perform a site-specific probabilistic and deterministic seismic hazard analysis to evaluate seismicity and provide a basis for selecting design ground motion parameters
- Potential liquefaction-derived settlement can be reduced to acceptable levels by the use of either ground improvement techniques (i.e., compaction grouting, vibro replacement, or deep soil mixing) or deep

foundations (i.e., drilled piers, rock columns, or drilled piles) that account for the estimated liquefaction-derived settlement.

- Mass wasting impacts are likely limited to the southern corner of the property, and these impacts, if any, can be mitigated by implementing geotechnical recommendations to stabilize the slopes or provide an adequate offset of the site facilities from existing slopes.
- Control groundwater drawdown to reduce possible subsidence to within an acceptable level
- Use soil amendments to stabilize expansive soil, or over-excavate and replace it with engineered fill
- Design buildings and foundations to withstand expansive soil (i.e., deeper foundations, use pre-stressed concrete)
- Design structures and equipment to meet seismic requirements of the most recent version of the California Building Code (CBC) (California Building Standards Commission [CBSC], 2019)
- Ancillary features (tanks, utility towers, etc.) will be designed and constructed in accordance with their respective design standards consistent with the standard of practice
- Analyze static and seismic stability of all permanent slopes and embankments
- If applicable, comply with the Division of Safety of Dams (DSOD) requirements for the construction and operation of hydraulic retention structures that are considered a jurisdictional dam (i.e., the hydrostatic compensation surface reservoir)
- Assign a geotechnical engineer and/or engineering geologist to the project to carry out the duties required by the CBC to assess geologic conditions during construction and to approve actual mitigation measures used to protect the facility from geological hazards
- Design and construct the below grade features to prevent collapse during all phases of the project life-cycle (i.e., construction, operation, closure, and post-closure)

5.4.5 Laws, Ordinances, Regulations, and Standards

Federal, state, county, and local Laws, Ordinances, Regulations, and Standards (LORS) applicable to geological hazards and resources are discussed below and summarized in Table 5.4-1. The local LORS discussed in this section are certain ordinances, plans, or policies of the City of Rosamond and Kern County. There are no federal LORS that apply to geological hazards and resources.

Table 5.4-1: Laws, Ordinances, Regulations, and Standards for Geological Hazards and Resources

LORS	Requirements/Applicability	Administering Agency	Application for Certification Section Explaining Conformance
State			
California Building Code, 2019	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity	California Building Standards Commission, State of California	Section 5.4.2.2
Alquist-Priolo Earthquake Fault Zone Act (Title 14, Division 2, Chapter 8, Subchapter 1, Article 3, CCR)	Identifies areas subject to surface rupture from active faults	California Building Standards Commission, State of California	Section 5.4.2.2
The Seismic Hazards Mapping Act (Title 14, Division 2, Chapter 8, Subchapter 1, Article 10, CCR)	Identifies secondary seismic hazards (liquefaction and seismically induced landslides)	California Building Standards Commission, State of California	Section 5.4.2.2
California Water Code, Division 3, Dams and Reservoirs, Part 1	Jurisdictional dam oversight	DSOD	Section 5.15.5.2.5
Local			
City of Rosamond, Specific Plan	City of Rosamond	City of Rosamond	Section 5.4.2.2
Kern County Municipal Code	Standards for grading, including permit requirements	Kern County, Building Inspection Division	Section 5.4.7

5.4.6 Agencies and Agency Contacts

Compliance of building construction with CBC standards is covered under engineering and construction permits for the GESC. Except for possible oversight of the compensation reservoir by DSOD (described in detail in Section 5.15, Water Resources), there are no other permit requirements that specifically address geologic resources and hazards. However, excavation/grading and inspection permits may be required before construction, and they will be included in the overall project construction permit (see Section 5.6, Land Use).

5.4.7 Permits and Permit Schedule

Except for possible oversight of the compensation reservoir by DSOD (described in detail in Section 5.15, Water Resources), no permits are required for compliance with geological LORS. However, the Kern County Building Inspection Department is responsible for inspections and for ensuring compliance with building standards.

5.4.8 References

American Society of Civil Engineers (ASCE). 2016. Minimum Design Loads for Buildings and Other Structures, ASCE Standard, ASCE/SEI 7-16.

California Geological Survey (CGS). 2002. California Geomorphic Provinces, Note 36. California Department of Conservation. December.

California Geological Survey (CGS). 2016. *Fault Activity Map. Geologic Data Map No. 6*. California Department of Conservation. Available online: https://maps.conservation.ca.gov/cgs/fam/. Accessed July 28, 2021.

California Geological Survey (CGS). 2017a. *CGS Seismic Hazards Program: Alquist-Priolo Fault Hazard Zones*. California Department of Conservation. Available online: https://maps.conservation.ca.gov/cgs/EQZApp/app/. Accessed July 28, 2021.

California Geological Survey (CGS). 2017b. *CGS Map Sheet 48: Historic Earthquakes, 1769 to 2015 – California (Magnitude 5.0-plus)*. California Department of Conservation. Available online: https://maps.conservation.ca.gov/cgs/DataViewer/. Accessed July 28, 2021.

California Geological Survey (CGS). 2017c. *CGS Map Sheet 48: Earthquake Shaking Potential for California*. California Department of Conservation. Available online: https://maps.conservation.ca.gov/cgs/DataViewer/. Accessed July 28, 2021.

California Geological Survey (CGS). 2018. *CGS Map Sheet 58: Deep-Seated Landslide Susceptibility*. California Department of Conservation. Available online: https://maps.conservation.ca.gov/cgs/DataViewer/. Accessed July 28, 2021.

Division of Mines and Geology, California Department of Conservation (CDOC). 1999. *Mineral Land Classification of Southeastern Kern County, California. Open-File Report 99-15*

Dojchinovski, D., L. Pekevski, and W. Guoxin, September 2012, Estimating Reservoir Induced Seismicity RIS Potential. Case Study – Kozjak Dam, 15th World Conference on Earthquake Engineering 2012, Lisbon Portugal, Vol. 16, pp. 12730-12736.

Natural Resources Conservation Service (NRCS), United States Department of Agriculture. 2021. Web Soil Survey. Available online: http://websoilsurvey.nrcs.usda.gov/. Accessed July 27, 2021.

U.S. Geological Survey (USGS). 1996. Schwartz, D. P., W.B. Joyner, R.S. Stein, R.D. Brown, A.F. McGarr, S.H. Hickmann, and W. H. Bakun, Review of Seismic Hazards Issues Associated with the Auburn Dam Project, Sierra Nevada Foothills, California, 1996, USGS Open File Report 96-0011, United States Geological Survey.

U.S. Geological Survey (USGS). 2014. Unified Hazard Tool. Available online: https://earthquake.usgs.gov/hazards/interactive/index.php. Accessed August 13, 2021.