Appendix F-2

Geotechnical Report



Red Bluff Solar Projects – Victory Pass and Arica

Desert Center, California

Clearway Renew LLC San Francisco, California

Terracon Project No. GR205045-Revised 4 October 7, 2020

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REPORT SUMMARY

TOPIC	OVERVIEW STATEMENT
Project Description	We understand the proposed developments include two sites totaling approximately 3,978 acres. The two sites will be developed with solar arrays.
Anticipated Pile Driving Design	Development of the photovoltaic solar project can be considered feasible from a geotechnical engineering standpoint. We anticipate pile installation via conventional methods, such as driving into a virgin subgrade may encounter difficulty and may result in early refusal and inadequate penetration, or else may cause excessive pile deflection, rotation or torsional rotation. Obstructions to pile driving could be encountered and such conditions may require
	pre-drilling using under-sized holes.
Proposed Geotechnical Investigation	Geotechnical explorations and laboratory testing are recommended. Exploration and testing will help confirm the expected conditions, as well as delineate areas of concern related to areas of increased gravel and cobbles and corrosive soils. A preliminary scope can be prepared at your request.
Purpose and Scope	The scope of services includes development and delivery of a Stage1. Stage1 provides a conceptual model of expected subsurface properties from a geotechnical and geologic perspective to aid in a preliminary assessment of the potential project challenges and risks. In addition, Stage1 provides preliminary concepts for site development, conceptual foundation design parameters, and construction considerations for the project.



PROPOSED PROJECT

DEVELOPMENT DESCRIPTION

- The proposed solar project array consists of two areas that will occupy approximately 1,946 acres and 2,032 acres at the Victory Pass and Arica Solar sites, respectively.
- The project will include trackers and pad mounted inverters.
- We understand each site will have a substation.



See INFORMATION SOURCES for a detailed list of sources used to generate this figure.



APPROACH AND METHOD

This report provides an expectation of subsurface properties from a geotechnical engineering perspective. It is intended to assist in considering preliminary concepts for site development and foundation options for the project. It is also intended to provide a basis for a subsequent exploration program to confirm the expected conditions as necessary to develop plans for site preparation and foundation construction. See INFORMATION SOURCES for a detailed list of sources used to generate this report.

A geotechnical engineer with local experience in the area of the planned project has formed an opinion of expected geotechnical conditions by reviewing the information as provided on the web page and our historic data in the vicinity of the project. The opinion rendered by the geotechnical engineer also includes an estimate of the confidence in that opinion. Finally, based upon the planned project, the information available and the confidence in the estimation of expected geotechnical conditions, the engineer has developed a general plan for exploration that will be necessary to confirm the expectations. For more information about our approach and method, please see METHODOLOGY AND LIMITATIONS.

EXISTING SETTING

GEOLOGIC SETTING

The site is located within an area mapped to consist of Quaternary-age alluvium. The site is mapped as having a depth to bedrock greater than 6 feet. Based upon our experience, we do not expect bedrock within the upper 25 feet of existing grades.

SURFICIAL GEOLOGY

Based on the California Geological Survey State Geologic Map, the on-site soils at the project site is mapped within the following geological units:

Q/Qs: Alluvium (Holocene to Pleistocene) – marine and nonmarine (continental) sedimentary rocks. Generally, consists of alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine but includes marine deposits near the coast.

BEDROCK GEOLOGY

Bedrock is not expected to be encountered on site.

FAULTING

The United States Geological Survey (USGS) Quaternary Fault and Fold Database of the United States published a report containing descriptions of a fault system approximately 15 miles northwest of the site called Blue Cut fault zone (Class A) and another fault system approximately 16 miles south of the site called Aztec Mine Wash fault (Class A). Additionally, the Hurricane fault zone (Class A) is mapped approximately 2¾ miles southeast of the site.

Additional, mapping by the California Geological Survey (Jennings and Bryant, 2010) indicate concealed fault traces immediately to the west of the site. These faults are considered pre-quaternary and are not active faults. Based on our review of the available fault information, it is our opinion that there is a low risk of surface rupture due to ground faulting on the project site.



USDA SOILS

The United States Department of Agriculture Natural Resources Conservation Service provides information on soils through its Web Soil Survey (WSS) website. The USDA did not have available data for this site.

GROUNDWATER

The site is not mapped with a known depth to water. Groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated during subsurface exploration. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Based on our review of the California Department of Water Resources well data, we anticipate groundwater to be encountered at depths greater than 70 feet within areas of the project site.

The site has not been previously mapped in FEMA's Flood Map or NRCS Flood frequency maps.

HISTORICAL AERIAL IMAGES SUMMARY

LOCATION	DESCRIPTION
Site	1995 - 2016: The site is presently undeveloped land and has appeared in this condition in all aerial images reviewed.



GEOLOGIC AND GEOTECHNICAL RISKS

HAZARD	PRESENT ON SITE?	COMMENTS
Shallow Groundwater	No	NRCS mapping and our historical projects do not indicate that shallow groundwater is present on site.
Flooding	Yes	Site is not mapped by the USDA Web Soil Survey as having a flood frequency. However, based on our experience on nearby projects, flooding depth and scour potential could be significant factors in solar array design. It is our opinion that a Civil Engineer should be engaged to asses potential scour depths.
Slope Failure	No	The project site is relatively flat with an overall slight descending slope to the northeast.
Subsidence - Pumping	No	No known groundwater pumping wells are located within the siting area. The depth to groundwater is significantly deep enough that the effects of any new wells will be global with differential settlements being minimized. Therefore, land subsidence impacts are anticipated to be low.
Subsidence – Mining	No	There are no publicly documented mines within the project site.
Subsidence – Caves/Karst	No	No known caves/karst topography is known to exist at the site.
Earthquake – Seismicity	Yes	This region of California is seismically active and moderate to severe seismic shaking on site should be anticipated.
Earthquake – Ground Rupture	No	Active faults are not mapped on the project site.
Liquefaction	No	Groundwater is anticipated to be deeper than 50 feet; therefore, the potential for liquefaction is anticipated to be low.
Swelling/Shrinking Soil	No	Expansive soils are not anticipated on site.
Hydro-Collapse Settlement	Possible	Deposits of soft, loose, granular soils that would result in excessive hydro-collapse settlement may be encountered at this site.
Seiche, Tsunami	No	The site is located a significant distance away from large water body sources. Therefore, hazards associated with Seiches and Tsunamis are anticipated to be low.
Corrosive Soil	Yes	Based on our experience in the area, moderate steel corrosion is estimated for the site.
Man-Made Ground	No	Areas of significant fill placement do not appear to exist.
Volcanic Activity	No	The site is not in a known region of potential volcanic activity.
Quick Clay	No	Sensitive clays are not anticipated at the site.
Frost Action	No	Frost is not a concern in this region.



GEOLOGIC AND GEOTECHNICAL HAZARD MITIGATION RECOMMENDATIONS

HAZARD	LIKELIHOOD	POTENTIALLY FATAL FLAW	SIGNIFICANCE	POTENTIAL MITIGATION MEASURES	RECOMMENDED NEXT STEPS
Shallow Rock	Low	No	Difficult pile driving conditions	Shallow rock is not a concern for this site	None
Shallow cobbles, boulders, or dense cemented soils	Moderate to High	Yes	Difficult pile driving conditions	Pre-drilling methods for installation of pile foundations may be implemented	Perform a pile load testing program implementing pre-drilling methods; Perform test pits to evaluate presence and frequency of cobles and boulders.
Shrink-Swell	Low	No	Potential vertical rise of foundation and roadway subgrade; Potential risk of cracking to structures	Fine-grained soils associated with shrink-swell conditions are not anticipated to be encountered on site.	Obtain shallow surface samples for laboratory testing to evaluate shrink-swell potential
Collapse Potential	Moderate	Possibly	Sudden reduction in subgrade support when water is introduced to soils; High risk for ancillary structures supported on mat foundations	Overexcavate and recompact soils beneath inverters, transformers or other equipment supported on shallow concrete mat foundations.	Perform borings with ring sample collection for laboratory testing to evaluate collapse potential
Seismicity	High	Possibly	Damage to infrastructure through inertial effects and ground displacements	Account for seismic loads in design.	None
Faulting	Low	Possibly	Ground displacements/offsets	Geologic mapping indicates that no active faults are mapped within the project site.	Perform a geologic reconnaissance to confirm that no faults are present.
Liquefaction	Low	Possibly	Loss of bearing capacity of foundation elements and liquefaction-induced settlement	Ground improvement, reconfigure to avoid liquefiable areas, use of mat foundations for building(s), seismic ties to tie foundations together for building(s), and/or add geogrid to reinforce earth.	Although liquefaction is not anticipated to be a concern on this site, we recommend that you perform a 50-foot boring within the substation along with laboratory testing to evaluate liquefaction hazard potential.
Corrosive Soil	Moderate	Possibly	Deterioration of foundation systems over time and shortened design life.	Epoxy coating of rebar, concrete type/additives. Consult with Corrosion Engineer to assess design life and thickness of galvanization for pile design.	Obtain shallow, surface samples for laboratory testing.
Frost Action	Low	No	Potential uplift/heave of the support systems and roadways	Frost is not anticipated to be a concern at this site.	N/A



SUMMARY OF FINDINGS

The provided opinions of subsurface conditions are very preliminary in nature. They must be validated with site-specific exploration and testing. This discussion is in no way intended for design, construction, or permitting purposes. In no case should the information or opinions provided in this report be utilized for final design. See METHODOLOGY AND LIMITATIONS for additional clarification regarding the limitations of the following opinions and methods used to derive these opinions.

CONFIDENCE ESTIMATE

We have used a weighted average approach, please refer to METHODOLOGY AND LIMITATIONS.





FOUNDATION DESIGN

CONSIDERATIONS	
Shallow Foundation support is acceptable for self-contained electrical structures (<100 kips):	Yes
Ground improvement likely required:	No
Deep Foundation support likely required for loads greater than 100 kips:	Yes
Anticipated Seismic Site Class:	D

- Shallow foundations are anticipated to be suitable for electrical equipment foundations
- Shallow excavations may be accomplished with conventional equipment.
- Transmission line towers and select substation structures can be supported on drilled shaft foundations.
- The determination of seismic design parameters in ASCE 7-16 includes site-specific procedures/analysis for projects in the area of the site. We may be required to provide site-specific seismic response spectra and design values according to ASCE 7-16, Section 21.2 and the 2019 California Building Code. However, ASCE 7-16 includes an exception from such analysis for specific structures on Site Class D/E sites. Based on our understanding of the proposed structures, it is our assumption that this exception applies to the proposed structure. However, the structural engineer should verify the applicability of this exception



PILE DRIVING

CONSIDERATIONS	
Pile installation via conventional methods likely	Yes (see note)
Pile driving refusal anticipated	Yes
Anticipated pile embedment depths	6-10 feet
Adfreeze stress based on frost heave	Negligible
Potential stress based on expansive soil heave (acting over box perimeter of the pile:):	Negligible

- We anticipate pile installation via conventional methods, such as driving into a virgin subgrade may encounter difficulty and may result in early refusal and inadequate penetration, or else may cause excessive pile deflection, rotation or torsional rotation.
- Obstructions to pile driving could be encountered and such conditions may require pre-drilling using under-sized holes.
- The NRCS Web Soil Survey have not mapped the potential for corrosion of steel or concrete in this area. Based on nearby projects, we anticipate a moderate potential for corrosion of steel on site.
- Stormwater detention ponds are typically used on these projects to prevent stormwater run-off.
- Scour depth will affect depth of pile embedment and should be considered in the final design embedment depth.

FOUNDATION DESIGN SOIL PARAMETERS GUIDE OF ESTIMATES

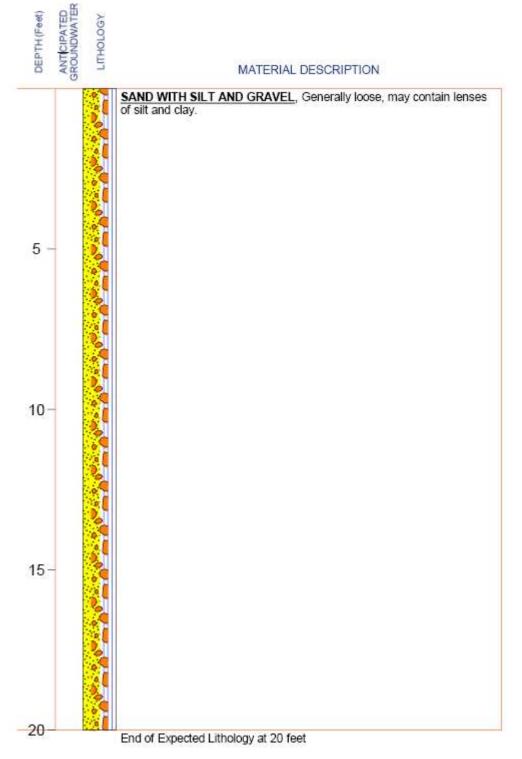
A guide of estimates of the design engineering parameters for driven steel piles, for generalized subsurface conditions provided in tabular form below. These values should be used for general informational purposes only. They should not be used for project design.

Depth	Material Description (Consistency)	Friction Angle (Degrees)	Ultimate Skin Resistance Uplift (psf/ft)	Ultimate End Bearing Pressure (psf)
0-5 ft	Cond (loose to modium dense)	20 to 20	45 to 45	
5 -10 ft	Sand (loose to medium dense)	30 to 36	15 to 45	5,000 to 10,000

For W-sections and other similar pile shapes, the box perimeter should be used to compute the actual area providing skin resistance to the applied loads, which will be less than the actual surface area of the pile.



EXPECTED LITHOLOGY: Entire Site



LITHOLOGY AND GEOLOGY NOTES

- The site is located in the Sonoran Desert section of the Basin and Range physiographic province.
- The site is located within an area mapped to consist of Quaternaryage alluvium.
- Groundwater is not anticipated within the typical depth of construction at this site.

The above expected lithology was prepared as a part of a Stage1 report. It should not be utilized or distributed outside of that report.



NEXT STEPS

In order to characterize the subsurface conditions, we recommend geotechnical explorations. Geotechnical explorations will provide the necessary sampling and testing to provide design parameter recommendations. The locations of our planned geotechnical explorations will be determined when a site plan is available.

FIELD EXPLORATION

Based on our experience within proximity to the project site, we recommend that for a design level geotechnical evaluation of the site, the geotechnical explorations on site include the following:

- 1 boring/test pit per 25 acres to depth of about 15 to 20 feet;
- 1 field electrical resistivity test per 50 acres;
- 1 pile load test location per 50 acres, to determine axial and lateral pile capacity. Each pile load test location should consist of a minimum of 2 piles, and where applicable, a 3rd pile should be installed to better define the compression capacity of the pile; and.
- Additional borings should be performed for any planned substations or transmission line structures.

LABORATORY TESTING

- Moisture contents
- Atterberg limits
- Sieve analysis
- Corrosion testing (pH value, sulfate, chloride, sulfide, total salt, box electrical resistivity, and redox potential) of on-site soils: 1 test per 50 acres
- Laboratory Thermal resistivity: 1 test per 100 acres

The above frequencies are for a design level exploration effort, if requested, a preliminary exploration scope could be developed.



INFORMATION SOURCES









TERRACON DATA	Terracon has 4 historical geotechnical projects within 3-miles of your project site. Of those, the local practitioner reviewed select exploration projects to gain a better understanding of potential subsurface conditions. The geotechnical project locations are illustrated on the Client Porta .
PUBLICLY AVAILABLE GIS DATA	California Geological Survey
AERIAL IMAGERY	Terracon reviewed the following readily available historical aerial images to develop a limited history of previous site usage: Historical Aerial Images Google Earth Pro™ The use of available aerial imagery resources is intended to help understand previous site usage. These images are widely spaced in time. They should not be considered appropriate for identifying site activities which may have impacted subsurface conditions. A more comprehensive review of aerial imagery and/or site interviews would be required to further evaluate previous site usage.
OTHER SOURCES	California Department of Water Resources FEMA Flood Mapping



METHODOLOGY AND LIMITATIONS

LIMITATIONS

This report provides very preliminary opinions of siting and construction challenges that may be associated with the stated project plans for the stated property. Confirmation of opinions stated in this document is essential. Absence of a mapped resource does not mean that it is not present. Confirmation should include performing a site-specific evaluation consistent with the guidelines set forth in NEXT STEPS.

All parties are advised that any decisions or actions taken by any party based on the information contained herein, including decisions with financial implications are done solely at the risk of that party. By providing this information in this preliminary form, Terracon expressly disclaims any duties or obligations associated with the usage of this information for decision-making or design purposes.

In the event that changes to the nature, design, or location of the project, as outlined in this report, are planned, the preliminary conclusions and recommendations contained in this report shall not be used unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing. In the event the project moves into the design phase, Terracon should be retained to develop and complete a scope of work that includes site specific explorations as noted in NEXT STEPS.

Terracon and Clearway Renew LLC recognize we have entered into an agreement that may contain certain confidential or non-disclosure obligations relating to our services. Clearway Renew LLC recognizes, however, that although such confidentiality obligations may be in place, those obligations do not create an exclusive relationship between the parties nor do those obligations create an exclusive ownership right to Clearway Renew LLC relating to the data in question. Terracon has the unfettered ability to provide similar services to any other party and use any public or previously available data for the service of others, even if included as part of this report, but Terracon will refrain from disclosing confidential information of Clearway Renew LLC which is provided by Clearway Renew LLC to the extent required by any applicable non-disclosure agreement.

Terracon does not represent the imagery reviewed to be a complete historical record of previous site usage, nor does Terracon validate the accuracy and sufficiency of the public domain sources that have been utilized.

METHODOLOGY

CONFIDENCE ESTIMATE

Terracon has assigned confidence estimates for the datasets based on upon the engineer's local practice in the vicinity of your site. The engineer assigned a subjective confidence opinion of low, moderate, or high for each of the following categories:

- Historical Project Data
- Local Experience
- Public Data

Using a weighted averaging approach, we derived an overall confidence interval in which historical project data was weighted more heavily than local experience which was weighted more heavily than public data. Low confidence implies that the level of available data and/or consistency is such that little confidence can be placed in the Conceptual Geotechnical Model. Conversely, a high confidence ranking implies that sufficient data and consistency exists to derive a high confidence in the statement of expected conditions.

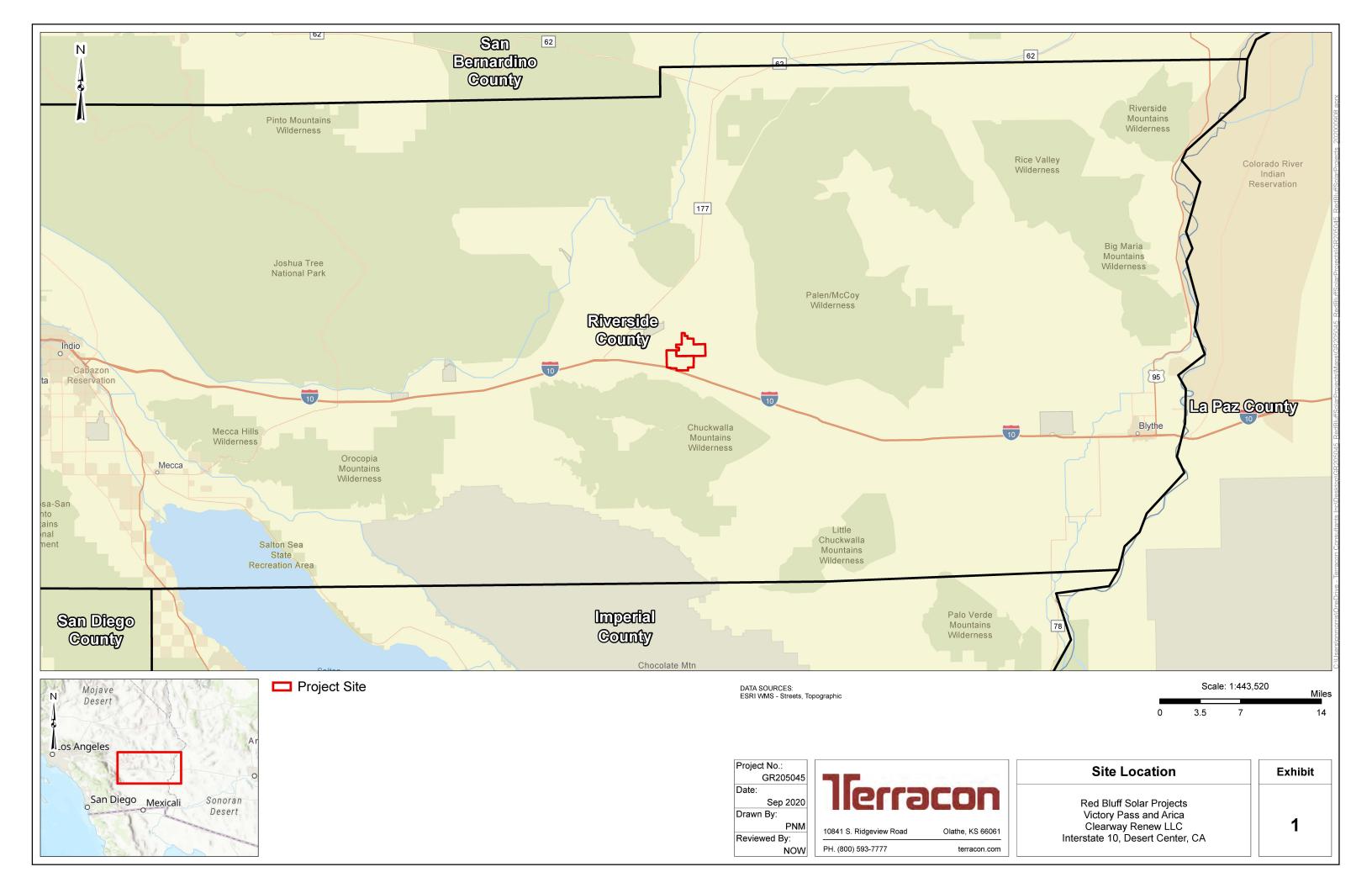
Regardless of the confidence ranking, actual conditions may vary significantly from the predicted conditions, and the expected conditions must be confirmed with site-specific exploration data, and significant variations from the expected conditions are possible.

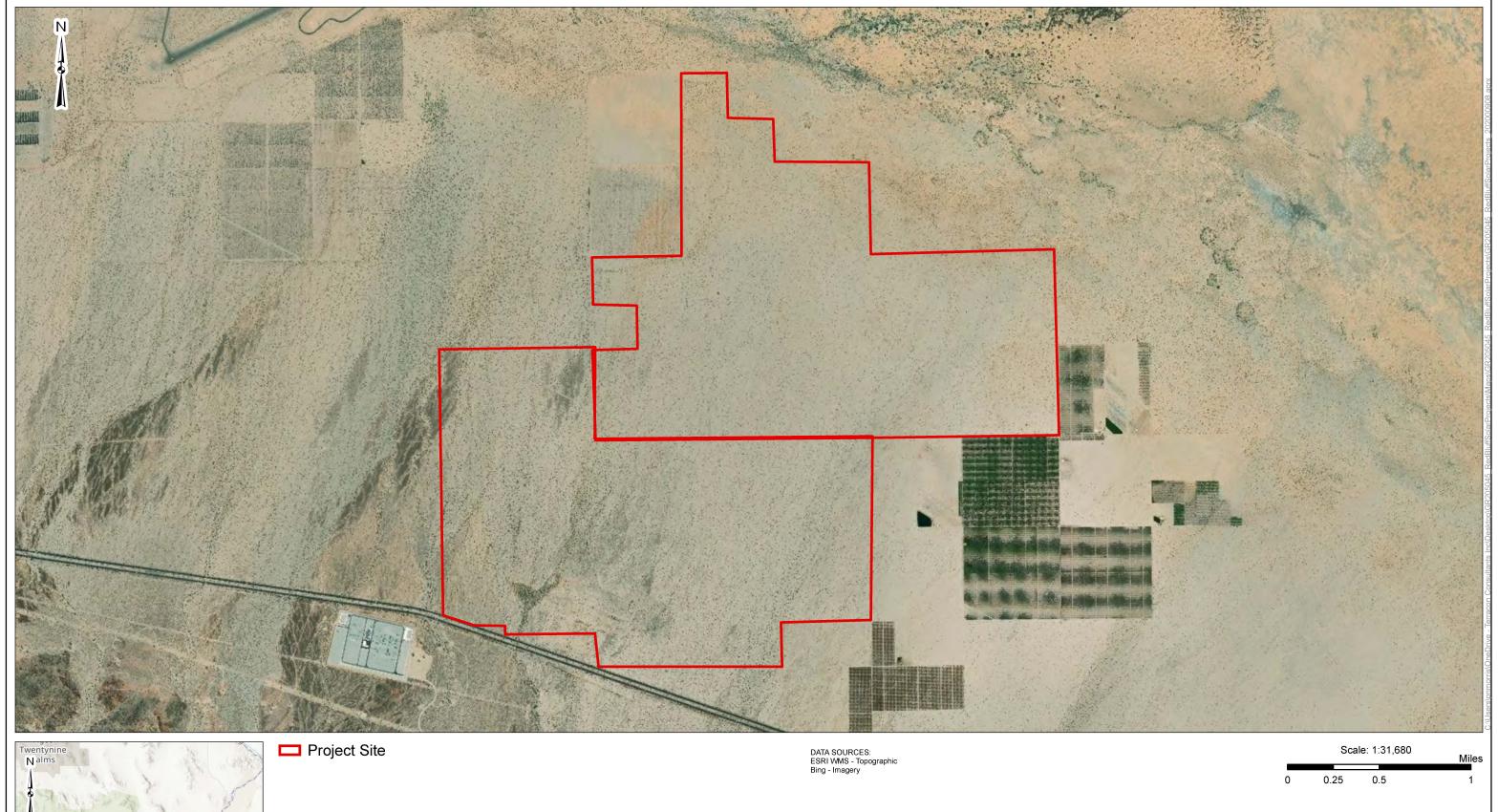


FIGURES

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Site Location Map
Site Layout
Site Topography
Surficial Geology Map
Geologic Map
Surficial Soil USCS Soil Classifications
Depth to Bedrock
Depth to Groundwater
FEMA Flood Zones







Project No.: GR205045 Date:

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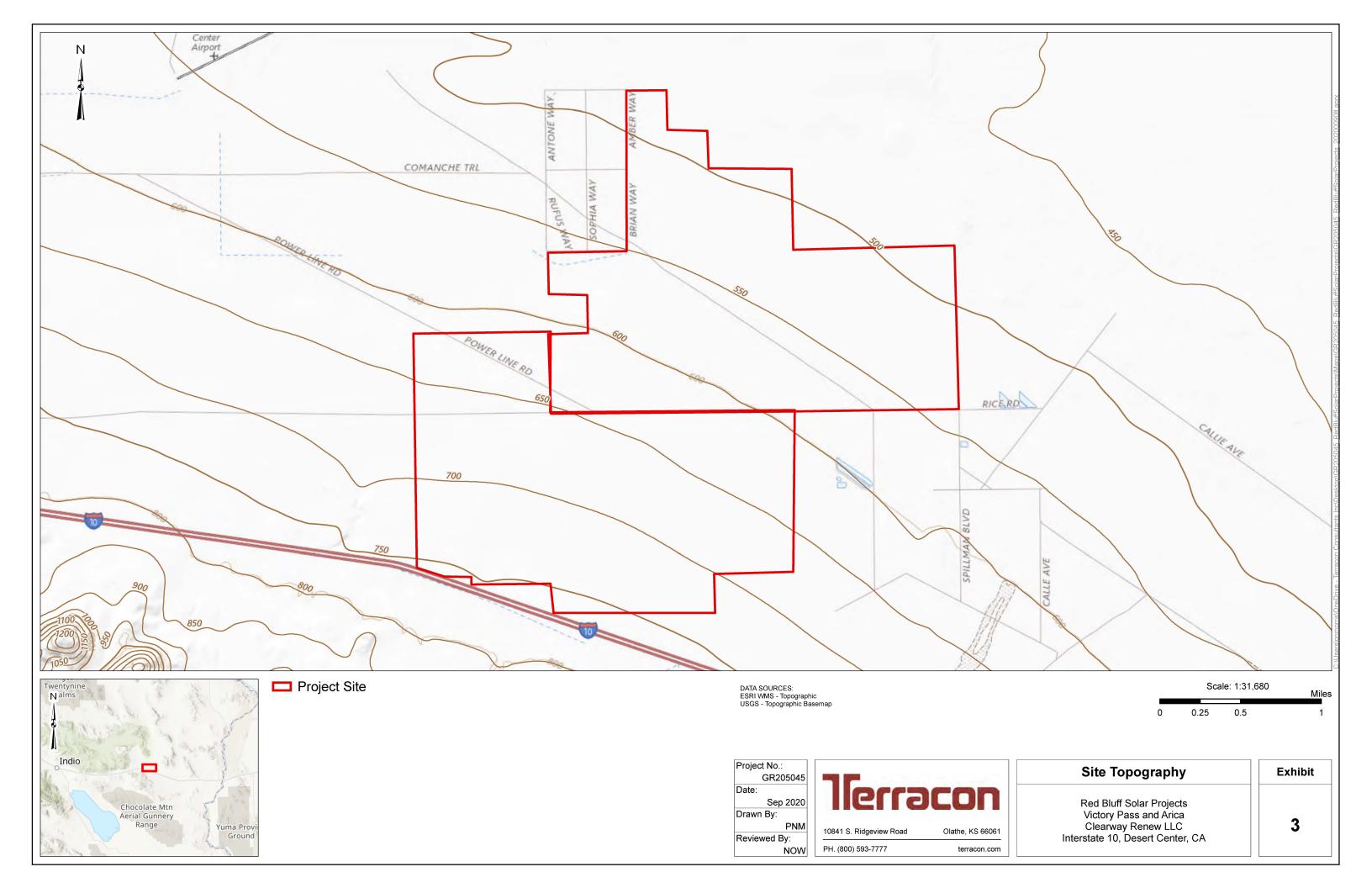
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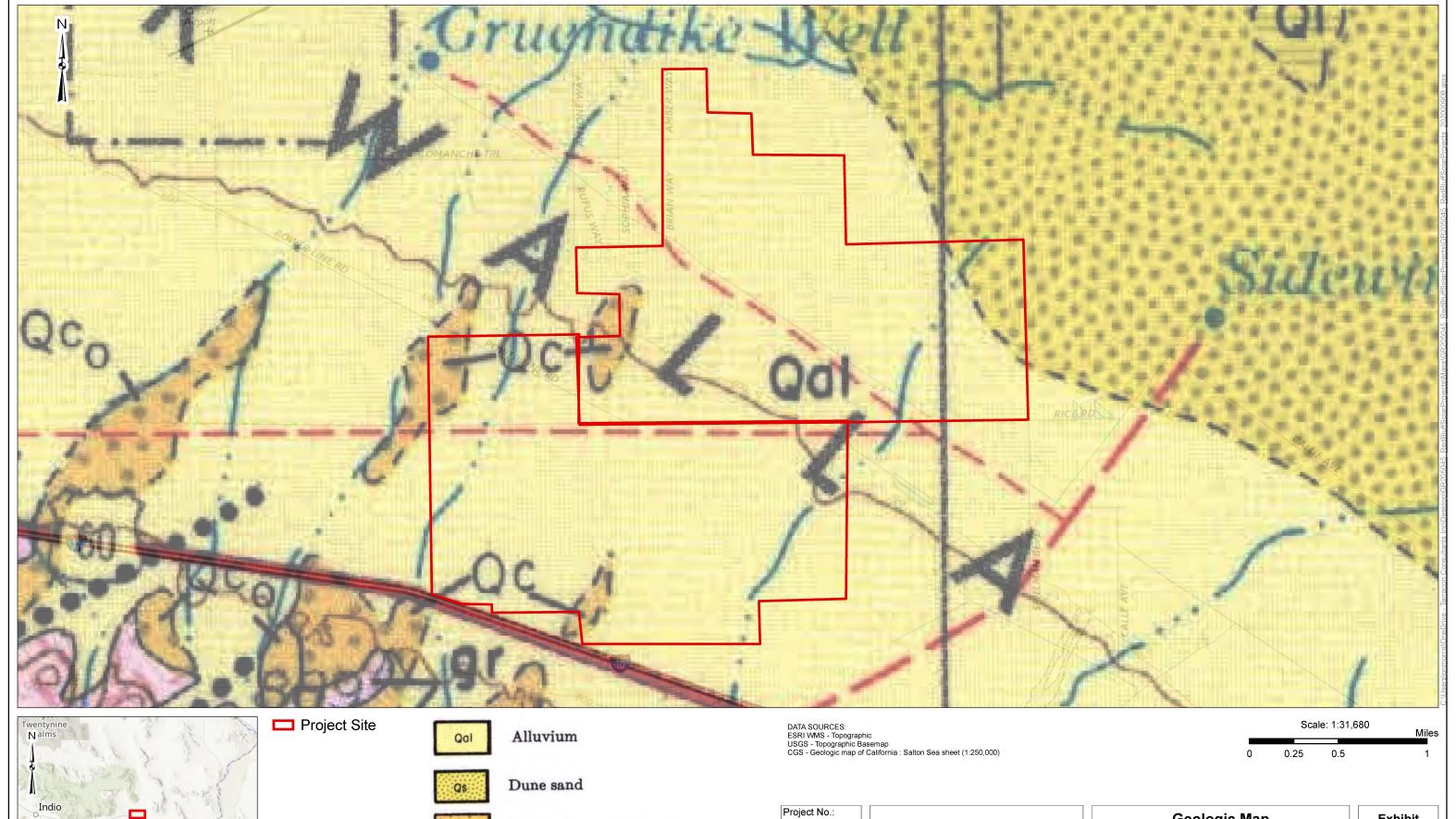
Site Layout

Red Bluff Solar Projects Victory Pass and Arica Clearway Renew LLC Interstate 10, Desert Center, CA

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Exhibit







Pleistocene nonmarine

Mesozoic granitic rocks: gr^a-granite and adamellite; gr⁹-granodiorite; gr[†]-tonalite and diorite

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Geologic Map

Exhibit

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