REPORT

GEOTECHNICAL INVESTIGATION SAN DIEGO GAS & ELECTRIC FALLBROOK BATTERY STORAGE PROJECT; PARCEL 1 FALLBROOK, CALIFORNIA

Prepared for

Mr. Mike Mochan
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127 Atlas Crossing Road
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AECOM Project No. 60534181

February 27, 2017

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SDC PDS RCVD 01-02-19
ZAP19-001

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Mr. Mike Mochan
Casteel Corporation
127 Atlas Crossing Road
Uniontown, PA 15401

Subject: Geotechnical Investigation
San Diego Gas & Electric
Fallbrook Battery Storage Project; Parcel 1
Fallbrook, California
AECOM Project No. 60534181

Dear Mr. Mochan:

AECOM Technical Services, Inc. is providing this final geotechnical report for the above-referenced project in accordance with our proposal dated January 9, 2017 and our request for contract extension dated January 24, 2017. This geotechnical report provides the findings from the subsurface exploration performed, a discussion of geologic and geotechnical conditions, and geotechnical recommendations for design and construction of the project.

If you have any questions regarding this report, or if we can be of further service, please contact us.

Sincerely,
AECOM Technical Services, Inc.

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Principal Geotechnical Engineer

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SECTION 1 INTRODUCTION

This report presents the results of AECOM Technical Services, Inc. (AECOM) geotechnical investigation for the proposed San Diego Gas & Electric Company (SDG&E) Battery Storage Project (Project) in Fallbrook, California. The Project site is located south of East Mission Road as shown on Figure 1.

1.1 PROJECT DESCRIPTION

The Project is planned to be constructed within an existing vacant lot. A site plan showing the Project location is presented in Figure 2. Based on a review of conceptual drawings, we understand that the Project consists of approximately 30 battery storage modular core containers that may be housed in a warehouse building, a main transformer, fifteen (15) isolation transformers, and an auxiliary transformer. We further understand that the equipment will be supported on shallow mat/pad foundations and the building may be supported on continuous footings.

An infiltration basin is planned for the Project. We expect the basin will be located at the northwest corner of the site, as that location is at the lowest elevation compared to the rest of the site.

We understand the Project is being designed by a joint venture between AES and Casteel Corporation, the Engineer, Procure, Construct (EPC) Contractor. The engineering recommendations presented in this geotechnical investigation report are suitable for Project design and construction.

1.2 SCOPE OF SERVICES

The purpose of our services was to evaluate the subsurface conditions at the site and perform preliminary geotechnical analyses to provide recommendations for design and construction of the proposed improvement. The scope of services included the following tasks:

- Performing a site reconnaissance and boring location mark out;
- Coordinating utility clearance through Underground Services Alert (USA);
- Engaging a contractor to complete geotechnical borings;
- Performing percolation testing;
- Performing geotechnical laboratory testing;
- Evaluating subsurface conditions (including soil and groundwater) at the site;
- Preparing engineering recommendations for the design and construction of the structure foundations, including bearing capacity, vertical subgrade modulus, and lateral resistance parameters;
- Developing of seismic design parameters in accordance with the California Building Code (CBC);
- Discussing earthwork/trenching considerations; and
- Preparing this geotechnical report.

SECTION 2 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included reviewing published geologic information, as well as performing additional subsurface explorations, infiltration testing, and geotechnical and electrical resistivity laboratory testing.

2.1 FIELD INVESTIGATION

Our geotechnical field investigation included six exploratory borings and two in-situ percolation tests. The explorations were extended to depths ranging from 6 to 19 feet below ground surface (bgs). The borings were advanced on February 1, 2017 and the percolation testing was completed in Borings P1 and P2 on February 2, 2017. The locations of the explorations are shown on the Site Plan (Figure 2).

The borings were advanced with a truck mounted drill rig using hollow-stem augers. Drive samples were collected during the drilling program. Bulk grab samples were collected from the upper foot of the surficial soil and returned to the geotechnical laboroatry. An AECOM engineering geologist and a geotechnical engineer supervised the drilling activities and logged and sampled the explorations.

The exploratory program is discussed further in Appendix A, which also presents the logs of the explorations. The descriptions on the logs are based on field logging and laboratory testing.

Testing to evaluate the infiltration characteristics of the subsurface was performed in Borings P1 and P2, which extended to depths of 6 feet bgs. Percolation testing was performed in general accordance with the testing procedure outlined by the County of San Diego, Department of Environmental Health guidelines titled "Design Manual for Onsite Wastewater Treatment Systems, County of San Diego Department of Environmental Health, Land and Water Quality Division," March 22, 2010 (Updated November 25, 2013). The summarized test data is presented in Section 5.5 below. Complete tables of data collected are presented in Appendix A, Figure A-8 (Percolation Test Data).

2.2 LABORATORY TESTING

The materials encountered in the borings were visually classified and evaluated with respect to relative density or consistency and moisture content. The samples were returned to our geotechnical laboratory for further examination and testing. The visual classifications were further evaluated by performing moisture content, unit weight, Atterberg Limits tests and grain size analyses. The shear strength of the soil was evaluated by correlating with the blow count and index test results. The pavement subgrade strength was evaluated by performing an R-Value test. Corrosion potential of the near-surface soil was also evaluated. Testing was performed in general accordance with ASTM International (ASTM) or other relevant standards.

Thermal resisitiviy testing of the subsurface materials was performed on select soil samples from the upper 5 feet of the surface. Thermal resisitivity tests were performed at various moisture contents in compliance with IEEE 442 specifications by NV5. Test results from the NV5 laboratory testing along with the corresponding thermal dryout curves are included in Appendix B.

Results of the geotechnical laboratory testing are presented at the corresponding sample locations on the boring logs in Appendix A; detailed results of the laboratory testing are presented in Appendix B.

SECTION 3 GEOLOGIC AND SITE CONDITIONS

Knowledge of the site conditions was developed from a review of the local geology, available information and current subsurface explorations.

3.1 GEOLOGIC SETTING

The project site is in the Peninsular Ranges geomorphic province and lies along the western margin of the foothills sub-province. The foothills sub-province is underlain by Cretaceous granitic rock and Jurassic age metavolcanic rocks overlain with Quaternary age alluvium, alluvial fans and valley fill deposits in the low lying areas.

The proposed battery storage Project area is underlain by variably weathered granitic rock. The ground surface in the Project area has been slightly modified for agricultural purposes. The site lies just to the south of the broad drainage area that is underlain by alluvial deposits. A Regional Geologic map on a topographic base is presented as Figure 3.

3.2 TECTONIC AND SEISMIC SETTING

The Project site, and southern California in general, lie in an active tectonic region. At the latitude of the study area, the interaction between the North American and Pacific plates is considered to take place across a wide area, extending from the San Andreas fault zone in the Imperial Valley to the east, to tens of miles offshore to the west.

The main fault zones are predominantly northwest trending right-lateral strike-slip faults. Other significant faults include northeast-trending left-lateral strike-slip conjugate faults, and locally, east-west trending reverse faults, and blind thrust faults.

To the west of the San Andreas fault zone, other main faults include the San Jacinto fault zone, Whittier-Elsinore fault zone, Newport-Inglewood-Rose Canyon fault zone and a complex zone of branching and stepping northwest-trending offshore faults. The major active faults closest to the site are the Oceanside section of the Newport-Inglewood-Rose Canyon fault zone located in the offshore zone to the west and the Elsinore fault zone located to the east. Active faults located farther offshore include the Palos Verdes-Coronado Bank fault zone and the San Diego Trough fault zone.

The active faults (i.e. Holocene-age fault rupture) and potentially active (i.e. Quaternary-age fault rupture) faults are shown on the Regional Fault and Epicenter Map, Figure 4.

The Temecula section of the active Elsinore fault zone lies approximately 8 miles to the east of the site. In the proximity of the Temecula section are the Wolff Valley fault and Murrietta Creek fault. The estimated maximum moment magnitude (Mw) of a seismic event on the Temecula section of the Elsinore fault zone ranges from 6.8 to 7.0. Larger magnitudes are possible if multiple faults in the area rupture in a single event with potential maximum moment magnitudes (Mw) ranging from 7.7 to 7.8 (USGS, 2008).

The Newport-Inglewood-Rose Canyon fault zone and the known active strands along the Oceanside section of the zone are located approximately 18 miles west of the site. Based on the USGS Quaternary fault and fold database website of National Seismic Hazard Maps, the estimated maximum moment magnitude (M_w) of a seismic event on the Newport-Inglewood-Rose Canyon fault zone ranges from 6.7 to 6.9 (USGS, 2008). Larger earthquake events may be possible if multiple segments of these fault zones rupture in a single event

3.3 SURFACE CONDITIONS

The site area is currently a moderately vegetated vacant lot. We understand the site was previously used as an avocado grove. The ground surface elevation of the Project area grades from approximately +810 feet to +790 feet Mean Sea Level (MSL) with a gentle slope down to the northwest.

3.4 SUBSURFACE CONDITIONS

The evaluations of subsurface conditions for the Project have been based on the borings performed for this investigation and our review of available geologic information. The subsurface consists of surficial fill and residual soil underlain by weathered granitic rock. These units are described below.

3.4.1 Fill / Residual Soil

Our explorations encountered shallow fill (interpreted to be disturbance caused by the previous agricultural activities) over residual soil. These surficial units, which extended to depths of 2 to 5 feet bgs, were observed to consist of silty to clayey sand.

3.4.2 Granitic Rock

The Project site is underlain by variably weathered granitic rock. The rock is completely weathered to a maximum depth of 5 feet as encountered in our borings. The completely weathered rock typically excavates to silty or clayey sand with some gravel and generally behaves as a medium dense to dense soil. The completely weathered rock becomes highly weathered below a depth of 5 feet bgs, which extended to target depths. Highly weathered rock typically excavates to silty sand, poorly graded sand or well-graded sand. For engineering design considerations we have developed a three layer soil profile as presented in Section 5.2.1 and consisting of; engineered fill (see recommendations in earthwork section below); completely weathered rock, and highly weathered rock. The recommended design parameters and associated depths for each profile layer are presented in Table 1 in Section 5.2.1.

A potentially significant construction consideration in this granitic rock setting is that even within the zone of completely or highly weathered rock (generally rippable conditions based on recent drilling information), there is a potential for less weathered rock to occur in localized zones that could result in marginally rippable or non-rippable conditions. These hard rock zones are sometimes referred to as core stones or "floaters" and can result in more difficult excavation conditions than in adjacent areas.

3.5 GROUNDWATER

A permanent groundwater surface was not encountered in the current explorations. Groundwater is anticipated to be greater than 25 feet bgs. Localized perched groundwater conditions may exist underlying the site.

SECTION 4 SEISMIC AND GELOGIC HAZARDS

This section presents our evaluations of the seismic and geologic hazards at the site based on review of available geologic information, the results of our current investigation, engineering evaluations and analyses, and professional judgment.

4.1 FAULT RUPTURE

The potential for surface fault rupture at the site is considered to be very low. The site is not located within California Geological Survey (CGS) Fault-Rupture Hazard Zones (Alquist-Priolo Earthquake Fault Zones). There are no active or potentially active faults within the site area based on regional geologic mapping and our investigations. The nearest active fault to the site is the Elsinore fault zone located approximately 8 miles east of the site. This fault is not considered to present a significant fault rupture hazard in the site area.

4.2 LIQUEFACTION AND SECONDARY EFFECTS

Liquefaction is a phenomenon in which loose to medium dense, saturated, granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength because of cyclic ground vibrations induced by earthquakes or other ground vibrations. This rearrangement and strength loss is followed by a reduction in bulk volume of the liquefied soils. The secondary effects of liquefaction include sand boils, settlement, reduced soil shear strength, lateral spreading and global instability (flow slides in areas with sloping ground).

The project site is predominately underlain by variably weathered dense and very dense granitic rock. Further, groundwater is expected to occur at depth within the fractured granitic rock. Therefore, the potential for liquefaction at the site should be very low.

Strong ground motion can cause the densification of soils, resulting in settlement of the ground surface. This phenomenon is known as seismically-induced settlement or seismic compaction, which typically occurs in dry, loose cohesionless soils. During an earthquake, soil grains may become more tightly packed due to the collapse of voids or pore spaces, resulting in a reduction in the thickness of the soil column. Given the dense and very dense nature of the subsurface materials, the potential for seismic compaction at the site is considered low.

4.3 LANDSLIDES AND SLOPE STABILITY

The Project site is relatively flat. No existing slopes are located within the Project area. Site grading creating new slopes or requiring retaining walls is not expected for the Project. The potential for landsliding to impact the Project is considered to be low.

4.4 EXPANSION AND COLLAPSE POTENTIAL

The on-site residual soil as well as the granitic rock weathering is predominately silty to clayey sand with a relatively low plasticity. Excessive swelling or shrinkage of the surficial soil/rock due to wetting and drying over time is not anticipated. The potential for expansive soil to impact performance of the proposed improvements is considered low.

Loose granular soils can be subject to collapse due to wetting and/or inundation. Collapse can occur in dry granular soils that have an unstable soil structure due to deposition or irrigation processes, typically with a skeletal structure that is weakly cemented by soluble salts or clay. Increases in moisture content can cause the interparticle cementation to reduce, causing changes in volume (collapse), especially when loaded. The native soils are primarily derived from weathering of the native granitic rock. Therefore, the potential for collapse at the site is considered low.

4.5 SETTLEMENT

The proposed improvements will be supported on shallow foundations. The soil and weathered granitic rock that will underlie the shallow foundations for the proposed improvements is dense to very dense. The estimated settlement has been evaluated with respect to the anticipated loads and has been incorporated in the engineering design. The potential for excessive settlement affecting the proposed development is low.

4.6 OTHER HAZARDS

The local geologic conditions indicate that other geologic hazards are not likely to affect the site. Given the geologic and hydrogeologic setting of the site, the potential for subsidence is very low. Given the location and relative elevation of the site, the potential for seiches or tsunamis affecting the site is considered very low. Similarly, the site is not located within a designated flood plain and the flood hazard is considered low. These hazards should not constitute constraints to proposed improvements.

SECTION 5 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

The discussions, conclusions, and recommendations presented in this report are based on the information provided to us, results of current subsurface explorations and laboratory testing, engineering evaluations and analyses, literature research, empirical correlations, and professional judgment.

The subsurface conditions at the site are suitable for the proposed development, provided the recommendations presented in this section are incorporated into the design and construction.

5.1 EARTHWORK

Earthwork should be completed according to SDG&E Standard Specifications and the most recent editions of applicable sections of the County of San Diego grading codes and the Standard Specifications for Public Works Construction (*i.e.*, Greenbook). The following sections provide further recommendations for general earthwork that are specific to the geotechnical conditions encountered. Due to the existing site topography and the proposed site improvements, earthwork for the project is anticipated to be minimal.

5.1.1 Site Preparation

Roots and other vegetative matter, should be removed and disposed either offsite or stockpiled for reuse in landscape areas. Existing infrastructure, if any, should be properly demolished and disposed at an appropriate facility offsite. Any other soil areas disturbed by the demolition should be removed and recompacted or replaced with non-expansive fill to the satisfaction of the Geotechnical Engineer.

Existing shallow fill and residual soils are not considered suitable for the support of the proposed improvements and therefore should be removed in its entirety and replaced as engineered fill. It is recommended that the proposed foundations, slabs-on-grade and pavements should be supported on engineered fill or completely weathered rock. Upon completion of removals, the surface within areas to receive fill should be scarified, moisture conditioned as necessary, and compacted prior to fill placement. Areas temporarily vacated during earthwork should be similarly scarified, moisture conditioned and reworked to the satisfaction of a Geotechnical Engineer before placing additional fill to avoid drying out and lamination along the fill interface. Localized deeper soft soils that may be identified during subgrade exposure should be locally removed and replaced with engineered fill. A geotechnical professional should make the final determination of actual removal depths in the field during earthwork.

5.1.2 Fill Materials

Any fill or backill used for the Project should consist of select fill. Most of the onsite material is anticipated to be suitable for use as select fill, otherwise Class 2 Aggregate Base, or another quarried or natural source, could be used. Select fill should meet the following criteria:

- Contain no rocks or hard lumps greater than three inches in maximum dimension;
- Have a well-graded particle size distribution containing at least 40% of material smaller than ¼ inch in size, and a fines content (percent, by weight, passing the No. 200 sieve) less than 35%.
- Have an Expansion Index of 30 or less when tested in accordance with ASTM D4829; and
- Not have any perishable, spongy, deleterious or otherwise unsuitable material.

The Geotechnical Engineer should review and test all proposed fill sources before their use.

5.1.3 Fill Placement and Compaction

Fill material should be moisture conditioned to achieve a uniform moisture that is above the optimum moisture content. Fill material should be placed in loose lifts no thicker than eight inches, or thinner as needed to achieve the specified relative compaction. Each lift should be compacted to not less than 90 percent relative compaction, using the latest version of ASTM D1557 as the compaction standard. Any fill within the upper two feet of finished grade should be compacted to not less than 95 percent relative compaction.

5.2 FOUNDATIONS

We anticipate that mat/pad type shallow foundations will be used to support the new facility structures (modular core containers and main, auxillary and isolation transformers) outside of the Battery Storage Array Warehouse and the warehouse will be supported on continuous footings. AECOM has not been provided with the preliminary foundation sizes.

Based on the expected foundation types described above, we have performed engineering evaluations for shallow foundation support for the proposed battery storage facility structures. The recommendations provided herein may be used in the design of the foundations for the Project.

5.2.1 Subsurface Soil Profile

We have developed a subsurface soil profile to define soil parameters for use in foundation design. The design parameters presented below are intended for use in foundation design and may not reflect actual soil properties. Actual subsurface conditions in the field may vary. We recommend a subsurface soil profile consisting of engineered fill from 0 to 3 feet bgs underlain by completely weathered granitic rock from 3 to 5 feet bgs over highly weathered granitic rock from 6 to 15 feet. Groundwater can be assumed to be below a depth of 25 feet. The following soil parameters indicated in Table 1 may be used.

Table 1
Subsurface Soil Profile
Fallbrook Battery Storage Project

Strata	Depth (feet)	Soil Classification	Friction Angle, Φ (degrees)	Cohesion, c (psf)	Unit Weight, γ (pcf)
Engineered Fill	0-3	Silty/Clayey Sand, SC/SM	33	0	120
Completely Weathered Granitic Rock	3-5	Clayey Sand, SC	35	0	125
Highly Weathered Granitic Rock	>5	Silty Sand, SM	38	0	130

Note:

1. psf – pounds per square foot.
2. pcf – pounds per cubic foot.

5.2.2 Allowable Bearing Pressure

All footings should bear on engineered fill or on undisturbed completely weathered rock and should be embedded at least 18 inches below lowest adjacent grade and should be at least 24 inches wide. The foundations supported on engineered fill or undisturbed completely weathered rock may be designed for an allowable bearing pressure of 3,000 or 4,500 pounds per square foot (psf), respectively. The footings should be fully embedded in engineered fill or undisturbed weathered rock and should not transition between fill and formational soils/weathered rock. A one-third increase may be applied to the allowable bearing pressure for temporary wind and seismic loading. Adjacent footings founded at different elevations should be located such that the slope from bearing level to bearing level is flatter than 1:1 horizontal:vertical (H:V).

5.2.3 Resistance to Lateral Loading

Resistance to lateral loads on the shallow foundations can be provided by passive resistance along the edge of the foundation and by frictional resistance along the bottom of the foundation. An allowable equivalent fluid weight of 250 or 300 pounds per cubic foot (pcf) may be used for passive resistance for footings or grade beams poured neat against engineered fill or completely weathered rock, respectively. The upper 12 inches of material in areas not protected by hardscapes should not be included in the calculation of passive resistance. If friction is to be used to resist lateral loads, an allowable coefficient of friction of 0.4 may be used between foundation concrete and engineered fill or undisturbed weathered rock. If frictional and passive resistances are combined, the allowable friction coefficient should be reduced to 0.3. Passive resistance may be increased by one-third for loads that include wind or seismic forces.

5.2.4 Settlement

We anticipate that shallow foundations designed with the bearing pressures presented above may settle approximately ½-inch when loaded.

5.2.5 Modulus of Vertical Subgrade Reaction

Mat or pad foundations may be designed using a coefficient of vertical subgrade reaction (k_1). We recommend a k_1 of 260 tons per cubic foot (tcf) (300 pounds per cubic inch (pci)) for mat/pad foundations bearing on engineered fill or completely weathered rock. The k_1 value is representative of the subgrade modulus as measured from a field load test using square plate of dimensions 1 ft by 1 ft. The value of the coefficient of subgrade reaction depends on the foundation dimensions. For any given foundation geometry and size, the above recommended modulus should be adjusted as follows:

Square Foundation: $$k_{(B\times B)} = k_1 \left[\frac{1}{B}\right]$$

Rectangular Foundation: $$k_{(B\times L)} = \frac{k_{(B\times B)}\,(1+0.5B/L)}{1.5}$$

Where,

$k_{(B\times B)}$ = coefficient of vertical subgrade reaction of a square footing having dimensions B ft x B ft (pci)

$k_{(B\times L)}$ = modulus of vertical subgrade reaction of a rectangular footing having dimensions of
B ft x L ft (pci)

k_1 = coefficient of vertical subgrade reaction of a footing measuring 1 ft x 1 ft (pci)

B = foundation width (ft), where B is either the lesser of the width of the column spacing or the width of mat foundation

L = foundation length (ft)

The above recommendations were developed from Terzaghi (1955) as referenced in Das (1999) and are appropriate for granular subgrade soil.

5.3 CONCRETE SLABS-ON-GRADE

A modulus of vertical subgrade reaction of 150 pci may be used to design the concrete slabs-on-grade constructed on engineered fill or completely weathered granitic rock. The Structural Engineer should design the thickness and reinforcement of concrete slabs-on-grade to accommodate concentrated loads and heavy distributed loads. Expansion joints and crack control sawcuts should be included at regular intervals.

Groundwater is expected to be below the planned improvements and special waterproofing measures are not anticipated for interior floor slab of the control shelter. However, waterproofing should be considered if minor moisture seepage through the floor slab due to external water sources, such as landscaping or ponding water, is a concern.

5.4 PAVEMENT

5.4.1 Flexible Pavements

The structural design of Asphalt Concrete (AC) flexible pavement depends primarily on anticipated traffic conditions, subgrade soils, and construction materials. Laboratory subgrade strength testing on a near-surface soil sample resulted in an R-Value of 57; we have assumed R-value of 45 to be representative of the as-graded condition of the pavement subgrade.

Table 2 provides recommended flexible pavement structural sections for a range of Traffic Indices (TI), which should be confirmed by the project civil engineer. The design assumes a pavement life of 20 years with normal maintenance. The sections assume properly prepared subgrade consisting of at least 12 inches of soil compacted to a minimum of 95 percent relative compaction, as determined by the latest version of ASTM D1557. The aggregate base should be placed at a minimum relative compaction of 95 percent. Aggregate base should conform to Section 26 of the Caltrans Standard Specifications or Section 200-2 of the "Standard Specification for Public Works Construction".

Table 2
Flexible Pavement Structural Sections
Fallbrook Energy Storage Project

Traffic Index	Asphalt Thickness (in)	Base Thickness (in)
5.0	3.0	4.0
6.0	3.5	5.0
7.0	4.0	6.0

5.4.2 Rigid Pavements

Portland cement concrete (PCC) pavements should be used in areas where dumpsters will be stored and picked up or in areas of anticipated heavy-truck traffic. Our experience indicates that heavy-truck traffic can shorten the useful life of AC sections. We preliminarily recommend the pavement section should consist of 6 inches of PCC over 4 inches of aggregate base or 7 inches PCC over prepared subgrade. The base and soil subgrade should be compacted as recommended above for flexible pavement. The concrete pavements should be provided with expansion joints at regular intervals.

5.5 STORMWATER CONSIDERATIONS

Measures should be taken to properly finish grade the site to direct surface water away from foundations. To avoid the potential for damage to the proposed improvements, we recommend that infiltration into the subsurface soil adjacent to the proposed improvements be avoided.

The project site is gently sloping to the northwest portion of the site. Subsurface infiltration properties were evaluated at the site by performing percolation testing in two of the borings, P-1 and P-2. Percolation rates were calculated in minutes per inch (mpi) per County guidelines. These data were then converted to an approximate infiltration rate in inches per hour using the Porchet Method. Percolation test measurements and calculated infiltration rates are presented in Table 3 below.

Table 3
Infiltration Rates and Percolation Test Measurements
Fallbrook Battery Storage Project

Test Location	Percolation Rate [1] (min/inch)	Percolation Rate (inches/hr)	Percolation Rate (cm/sec)	Infiltration Rate[2] (inches/hr)
P-1	288	0.21	1.48E-04	0.0097
P-2	304	0.20	1.40E-04	0.0073
Average	296	0.205	1.44E-04	0.0085

Note:

1. Percolation rates as determined by borehole percolation tests.
2. Infiltration rate based on conversion from percolation rate using Porchet Method.

The measured infiltration rates are indicative of sand or a sand/clay mixture, which is consistent with the material observed in the borings (weathered granitic rock, typically a silty sand to clayey sand). We recommend a Project site-specific design infiltration rate of less than 0.01 inches per hour to be used in Worksheet C.4-1: Factor of Safety and Design Infiltration Rate Worksheet (County of San Diego 2016 Storm Water Standards) for calculating a design infiltration rate, which indicates "No Infiltration" condition.

5.6 SEISMIC DESIGN

The Project area will likely be subject to moderate to severe ground shaking in response to a local or more distant large-magnitude earthquake occurring during the expected life of the proposed facilities.

For design in accordance with the 2016 CBC (based on ASCE 7-10), the following parameters should be used. These parameters are developed in the code based on Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motion response accelerations. For the purposes of seismic design, we have classified the site as Site Class C.

Table 4
2016 California Building Code (CBC) Seismic Coefficients
Fallbrook Battery Storage Project

2016 CBC Seismic Coefficients Parameter	Value	Reference
Site Class	C	ASCE 7-10, Table 20.3-1
Mapped Spectral Acceleration - Short Period, S_s (g)	1.236	2016 CBC Figure 1613.3.1(2)[1]
Mapped Spectral Acceleration - 1 Sec. Period, S_1 (g)	0.478	2016 CBC Figure 1613.5(4)[1]
Site Coefficient - Short Period, F_a	1.000	2016 CBC Table 1613.3.3(1)[1]
Site Coefficient - 1 Sec. Period, F_v	1.322	2016 CBC Table 1613.3.3(2)[1]

2016 CBC Seismic Coefficients Parameter	Value	Reference
MCE[2] Spectral Response Acceleration - Short Period, S_{MS} (g)	1.236	2016 CBC Equation 16-37, $S_{MS}=F_aS_S$
MCE[2] Spectral Response Acceleration - 1 Sec. Period, S_{M1} (g)	0.632	2016 CBC Equation 16-38, $S_{M1}=F_vS_1$
Design Spectral Response Acceleration - Short Period, S_{DS} (g)	0.824	2016 CBC Equation 16-39, $S_{DS}=2/3*S_{MS}$
Design Spectral Response Acceleration - 1 Sec. Period, S_{D1} (g)	0.421	2016 CBC Equation 16-40, $S_{D1}=2/3*S_{M1}$

Notes:
1. Calculated using U.S. Seismic Design Maps web application developed by USGS.
2. MCE – Maximum Considered Earthquake.
3. Site coordinates estimated from 'Google Earth' computer program used to evaluate coefficients: 33.38525; -117.23473.

5.7 CORROSIVITY

A near-surface sample was tested for chemical properties associated with corrosivity. Results are presented in Appendix C. Laboratory testing resulted in a minimum electrical resistivity of 1,560 ohms-centimeter (ohm-cm); these soils may be considered "Fairly corrosive" to metallic utility piping and conduits. The results of the near-surface tests indicate that the soil has negligible potential for chloride and sulfate attack to concrete.

A corrosion engineer should be consulted for additional design recommendations. The type of concrete and corrosion protection for steel should be determined by the structural and/or corrosion engineer.

5.8 CONSTRUCTION CONSIDERATIONS

5.8.1 Excavation Characteristics

Excavations will be primarily in relatively shallow surficial soils and weathered granitic rock. Shallow foundation and trench excavation in surficial soils is expected to encounter little difficulty and weathered rock is expected to encounter moderate difficulty using modern trenching machines, drill rigs or backhoes for shallow excavations. Conventional earth moving equipment (bulldozers, backhoes, excavators, etc.) should also be able to excavate these deposits to shallow depths with moderate difficulty. Localized corestones and moderately weathered granitic rock should be anticipated within the project area. Moderate to heavy ripping effort and rock excavation techniques may be required for deeper excavations.

This assessment assumes that the excavating equipment is well maintained and operating at factory-specified efficiencies. The choice of excavation method is often a function of economics, level of desired effort, logistics, quality and size of machinery used, permit conditions, and contractor convenience.

5.8.2 Temporary Slopes

The design and construction of temporary slopes, as well as their maintenance and monitoring during construction, is the responsibility of the Contractor. The Contractor should have a geotechnical or geological professional evaluate the soil/rock conditions encountered during excavation to determine permissible temporary slope inclinations and other measures as required by California OSHA

(Cal/OSHA). The Contractor's geotechnical or geological professional may use the factual information provided in this report, as well as any additional data they may need to acquire, to assess the stability of temporary slopes and prepare a specific temporary slope analysis and/or develop parameters to design temporary support systems.

Based on the existing data interpreted from site reconnaissance and subsurface exploration, the design of temporary slopes and benches for planning purposes may assume Cal/OSHA Type C for subsurface soils.

Existing infrastructure that is within a 2:1 H:V line projected up from the bottom edge (toe) of temporary slopes should be monitored during construction.

The Contractor should note the materials encountered in construction excavations could vary significantly across the site. The above assessment of Cal/OSHA soil type for temporary excavations is based on preliminary engineering classifications of material encountered in widely spaced excavations. The Contractor's geotechnical or geological professional should observe and map mass excavations and temporary slopes at regular intervals during excavation and assess the stability of temporary slopes, as necessary.

The tops of all excavations should be graded to prevent runoff from entering the excavation. Temporary slopes should not be allowed to become soaked with water or to dry out. Surcharge loads should not be permitted near the edge of excavations; they should be located a horizontal distance greater than the depth of the cut, measured horizontally from the top edge of the excavation, unless the cut is properly shored and designed to accommodate the surcharge.

5.9 CONSTRUCTION OBSERVATION AND TESTING

Earthwork and placement of engineered fill should be performed under the observation and testing services of a geotechnical professional supervised by a California-registered Geotechnical Engineer. Tests should be taken to determine the in-place moisture and relative compaction of engineered fill. Observation and mapping of removals of unsuitable materials and any temporary excavations should be performed by the project geotechnical consultant.

All foundation excavations, and slab and pavement subgrade soils, should be continuously observed by a geotechnical or geologic professional prior to placement of steel and concrete to observe that the subgrade is satisfactory. Foundation excavations should be free of soft, loose and disturbed soils.

A California-registered Geotechnical Engineer should prepare a final report of foundation installation, and earthwork testing and observation.

5.10 ADDITIONAL GEOTECHNICAL SERVICES

AECOM has prepared this report based on available assumptions of Project design. Once the Project design is progressed sufficiently, AECOM should review the plans and confirm the recommendations provided in this report are applicable. We also recommend that AECOM assist engineering changes during construction and review final construction documentation, including drawings, specifications and special provisions. We recommend that AECOM observe earthwork observation and provide testing as applicable, including foundation bearing surfaces.

SECTION 6 LIMITATIONS

AECOM has observed only a very small portion of the pertinent subsurface conditions. The recommendations presented in this report are based on the assumption that soil and geologic conditions do not deviate appreciably from those observed in the previous and current subsurface explorations.

We recommend that AECOM provide observation and testing during subgrade preparation and fill placement, utility trench backfill, foundation excavations, and other forms of geotechnically significant types of construction to evaluate if the site conditions are as anticipated, or to provide revised recommendations, if necessary. If variations or undesirable geotechnical conditions are encountered during construction, AECOM should be consulted for further recommendations.

This report is not a contractual statement of geotechnical conditions (baseline report). The contractor should make their own interpretations using the factual information provided in this report.

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgments presented herein are based partly on our understanding of the proposed construction, and partly on our general experience. Our engineering work and judgments rendered meet current professional standards; we do not guarantee the performance of the project in any respect.

SECTION 7 REFERENCES

ASCE, 2010. Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, 2010.

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NAVFAC, 1982. Foundations and Earth Structures, Design Manual 7.2. Department of the Navy, Naval Facilities Engineering Command, May 1982.

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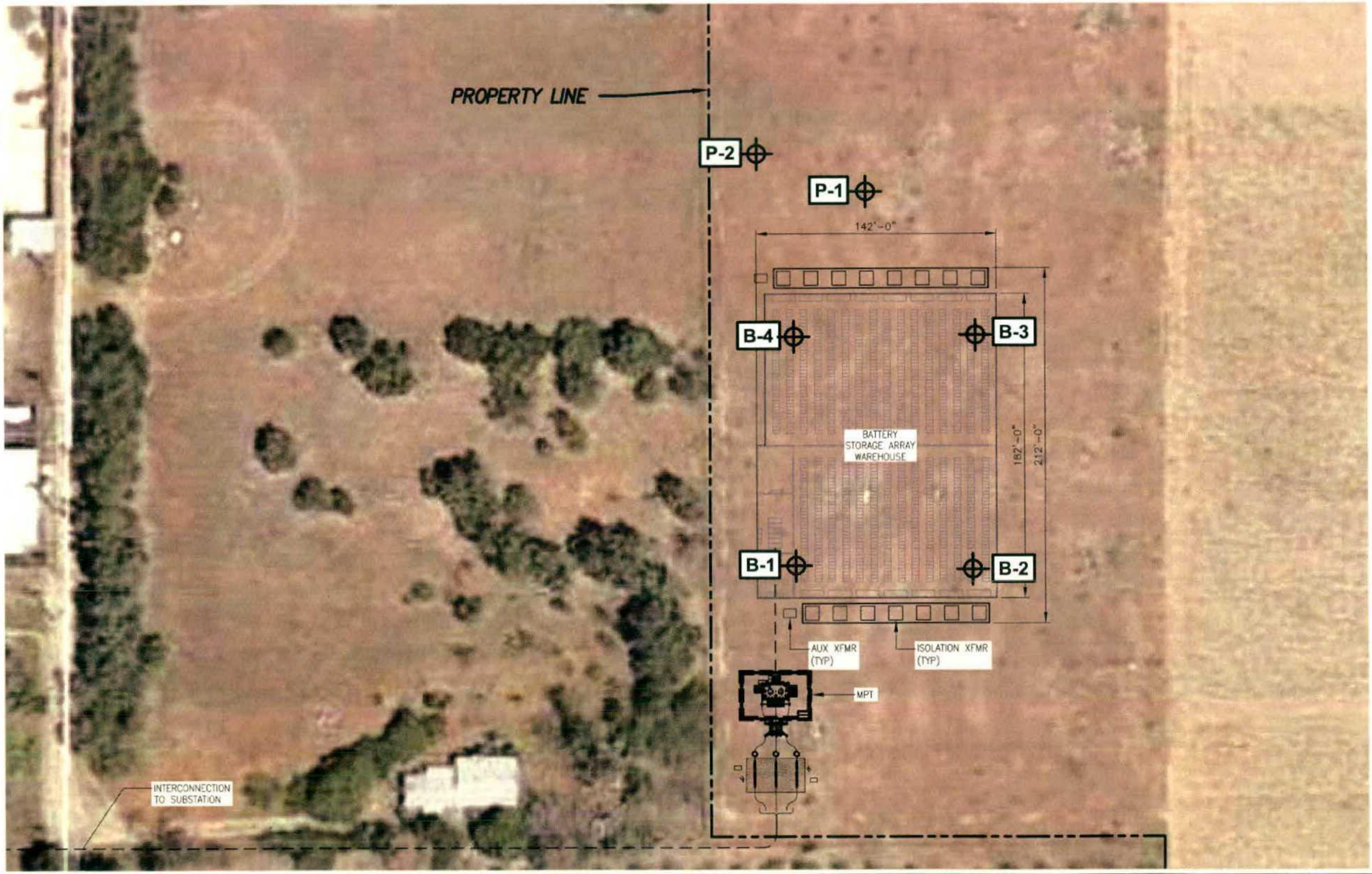
VICINITY MAP
SDG&E FALLBROOK BATTERY STORAGE PROJECT
FALLBROOK, CA

AECOM

0
NO SCALE

CHECKED BY: PB	DATE: 02-21-17	FIG. NO:
PM: SMF	PROJ. NO: 60534181	1

U:\Projects_Jobs\60534181_Casteel\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 1 - Vicinity Map.dwg Feb 23, 2017 - 4:17pm .



LEGEND

B-1 APPROXIMATE BORING LOCATIONS

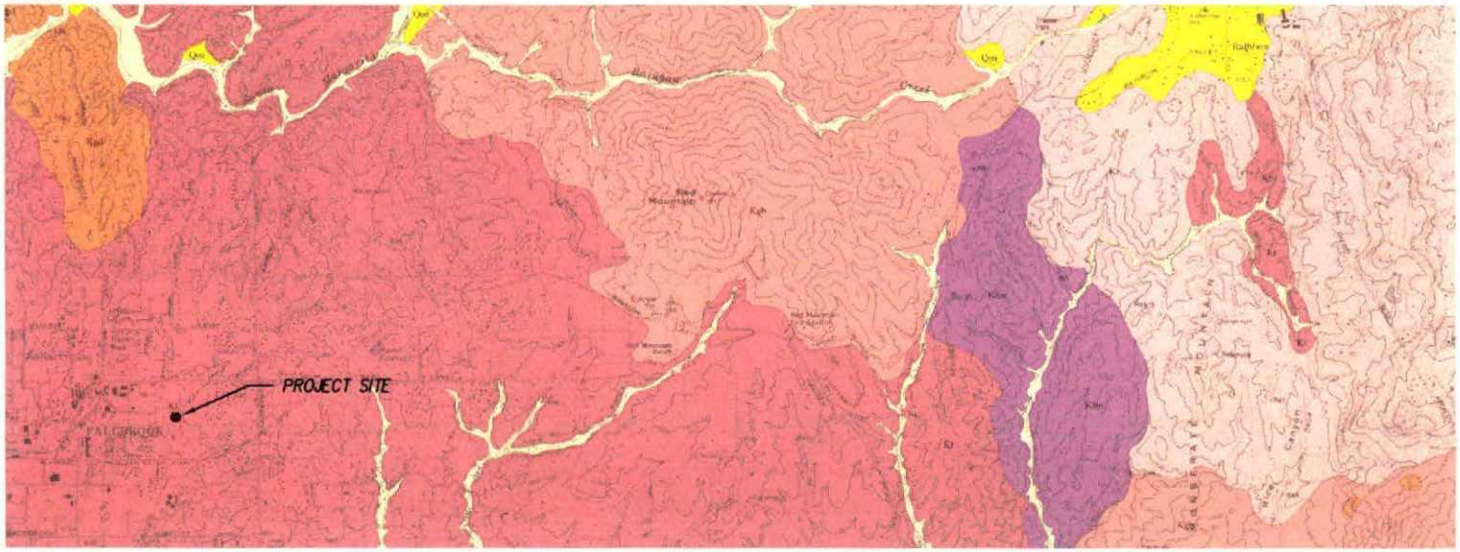
P-2 APPROXIMATE PERCOLATION TEST LOCATIONS

SITE PLAN
SDG&E FALLBROOK BATTERY STORAGE PROJECT
FALLBROOK, CA

AECOM

40 0 40 80 FEET SCALE: 1"= 80'	CHECKED BY: PB	DATE: 02-21-17	FIG. NO: 2
	PM: SMF	PROJ. NO: 60534181	

U:\Projects_Jobs\60534181_Casteel\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 2 - Site Plan.dwg Feb 23, 2017 - 4:19pm



LEGEND

EXPLANATION OF MAP UNITS

MODERN SURFICIAL DEPOSITS - Sediment that has been recently transported and deposited in channels and washes, on surfaces of alluvial fans and alluvial plains, and on hillslopes and in artificial fills. Soil profile development is non-existant. Includes:

Qa	Active alluvial flood plain deposits (late Holocene) - Unconsolidated to locally poorly consolidated sand and gravel deposits in active alluvial flood plains.
Qls	Landslide deposits (Holocene to Pleistocene) - Landslide slump and rock fall deposits.

OLD SURFICIAL DEPOSITS - Sedimentary units that are moderately consolidated and slightly to moderately well dissected. Older surficial deposits have upper surfaces that are capped by moderately to well-developed pedogenic soils. Includes:

Qoa	Older alluvial flood plain deposits (Pleistocene, younger than 500,000 years) - Mostly moderately well consolidated, poorly sorted, permeable flood plain deposits.
Qp	Pauba Formation sandstone facies (Pleistocene) - Light-brown moderately well-indurated, extensively crossbedded, channeled and filled sandstone and siltstone that contains occasional intervening cobble-and-boulder conglomerate beds.
Qpf	Pauba Formation fanglomerate facies (Pleistocene) - well-indurated poorly sorted sedimentary breccia and mudstone.

BEDROCK UNITS

Kr	Granodiorite of Rainbow (Cretaceous) - Leucocratic hornblende-biotite granodiorite; medium to coarse grained, massive.
Kgd	Granodiorite undivided (Cretaceous) - Mostly hornblende-biotite granodiorite; coarse to medium grained.
Kt	Tonalite undivided (Cretaceous) - Mostly hornblende-biotite tonalite; coarse grained, light gray.
Kgb	Gabbro undivided (Cretaceous) - Mostly biotite-hornblende-hypersthene gabbro; coarse grained, dark gray, massive.
KJm	Metavolcanic and metasedimentary rocks undivided (Cretaceous and Jurassic) - Low grade (greenschist facies) rocks that are in part coeval with and in part older than the Cretaceous plutonic rocks they lie in contact with.

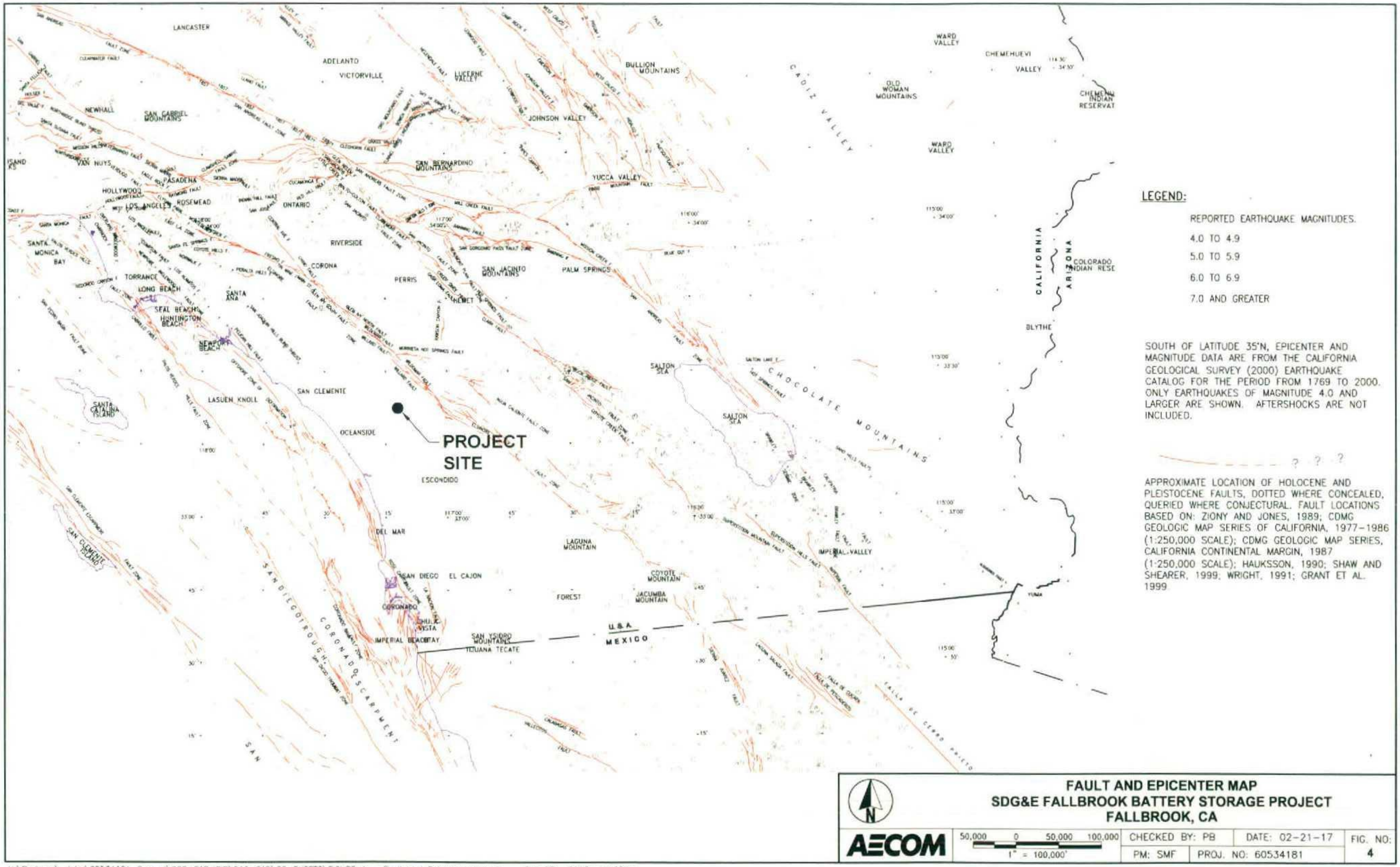
REGIONAL GEOLOGIC MAP
SDG&E FALLBROOK BATTERY STORAGE PROJECT
FALLBROOK, CA

AECOM

0 NO SCALE

CHECKED BY: PB	DATE: 02-21-17	FIG. NO:
PM: SMF	PROJ. NO: 60534181	3

U:\Projects_Jobs\60534181_Casteel\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 3 - Regional Geologic Map.dwg Feb 23, 2017 - 4:21pm



LEGEND:

REPORTED EARTHQUAKE MAGNITUDES.

4.0 TO 4.9

5.0 TO 5.9

6.0 TO 6.9

7.0 AND GREATER

SOUTH OF LATITUDE 35°N, EPICENTER AND MAGNITUDE DATA ARE FROM THE CALIFORNIA GEOLOGICAL SURVEY (2000) EARTHQUAKE CATALOG FOR THE PERIOD FROM 1769 TO 2000. ONLY EARTHQUAKES OF MAGNITUDE 4.0 AND LARGER ARE SHOWN. AFTERSHOCKS ARE NOT INCLUDED.

? ? ?

APPROXIMATE LOCATION OF HOLOCENE AND PLEISTOCENE FAULTS, DOTTED WHERE CONCEALED, QUERIED WHERE CONJECTURAL. FAULT LOCATIONS BASED ON: ZIONY AND JONES, 1989; CDMG GEOLOGIC MAP SERIES OF CALIFORNIA, 1977-1986 (1:250,000 SCALE); CDMG GEOLOGIC MAP SERIES, CALIFORNIA CONTINENTAL MARGIN, 1987 (1:250,000 SCALE); HAUKSSON, 1990; SHAW AND SHEARER, 1999; WRIGHT, 1991; GRANT ET AL. 1999

U:\Projects_Jobs\60534181_Casteel\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 4 - Fault and Epicenter Map.dwg Feb 23, 2017 - 4:22pm

Our field investigation consisted of a geotechnical program that included six exploratory borings and two in-situ percolation tests. The borings performed for this investigation by AECOM at the Project site to depths ranging from 6 to 19 feet bgs. The locations of the explorations are shown on the Site Plan (Figure 2).

AECOM prepared an internal safe work plan for the project. Prior to field activities, AECOM notified Underground Service Alert (USA) to locate underground utilities.

The borings were advanced by Pacific Drilling with a truck mounted Marl M5 drill rig using hollow-stem augers, and were designated B-1 through B-4 and P-1 and P-2. Grab, bulk and drive samples were collected from the borings. The drive samples were obtained using a Standard Penetration Test (SPT) sampler and a split-spoon sampler (2.5-inch inside diameter). Blow counts required to drive the samplers the final 12 inches were recorded to evaluate the relative density or consistency of the subsurface material. The reported field blow counts have not been corrected for sampler size or depth. The drive samples and cuttings were reviewed and classified according to the Unified Soil Classification System. The borings were backfilled with a bentonite seal and soil cuttings.

Locations of the field explorations are presented in Figure 2. A Key to Logs is presented as Figure A-1. Logs of the borings are presented as Figures A-2 through A-7.

Percolation tests were performed in Borings P-1 and P-2 to evaluate the infiltration rate. The test holes were presoaked at the completion of drilling (February 1, 2017) by filling each hole with about 12 to 18 inches of water. This water level was maintained for about 4 hours. The water was then allowed to infiltrate overnight to generate a "wetted zone" prior to testing. The following day (February 2, 2017), it was observed that the presoak water had dissipated into the subsurface. Water was then added to each of the holes to a depth approximately 12 to 14 inches above the bottom of the hole. The depth to water from a fixed point at the surface was noted. Depth measurements were then collected on a regular interval. The last measurement is used to calculate the infiltration rate. An electronic sounder was used to make the depth measurements to the accuracy of 1/100th of a foot in order to measure the amount of drop (or percolation).

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Key to Logs

Elevation, feet	Depth, feet	SAMPLES Type	Number		Graphic Log	MATERIAL DESCRIPTION	Dry Density, pcf	Dry Density, pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to NAVD88 or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number. Unnumbered sample indicates no sample recovery. "1-1" indicates geotechnical sample. "(B-1@1')" indicates analytical sample.

5 **Blows per foot:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop.

6 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

7 **Material Description:** Description of material encountered; may include relative density/consistency, moisture, color, particle size; texture, weathering, and strength of formation material. If shown, designation in parentheses denotes Munsell color classification.

8 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

9 **Dry Unit Weight:** Dry unit weight of soil sample measured in laboratory, in pounds per cubic foot.

10 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

SA	Sieve analysis, %<#200 sieve
WA	Three-point wash sieve, %<#200 sieve
LL	Liquid limit (from Atterberg limits test), %
PI	Plasticity Index [LL - PL], %; NP=nonplastic
CORR	Corrosivity Test suite
COMP	Compaction Curve (ASTM 1557D)
R-Value	R-Value test
THER	Thermal Resistivity Test (IEEE 442)

TYPICAL MATERIAL GRAPHIC SYMBOLS

Silty SAND (SM)

Clayey SAND (SC)

Poorly-graded SAND (SP)

Poorly-graded SAND with clay (SP-SC)

Well-graded SAND with silt (SW-SM)

Poorly-graded SAND (SP-SM) with silt

TYPICAL SAMPLER GRAPHIC SYMBOLS

Standard Penetration Sampler

2.5" ID Drive Sample

Bulk Sample

OTHER GRAPHIC SYMBOLS

First water encountered at time of drilling and sampling (ATD)

Static water level measured in boring or well at specified time after drilling

Change in material properties within a lithologic stratum

Inferred contact between strata or gradational change in lithology

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.

2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring B-1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.7 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	803 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38518, W: -117.23492		

Elevation, feet	Depth, feet	Samples: Type	Samples: Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Approximately 1-foot of Fill over dense, moist, dark brown silty SAND (SM), with trace clay			
800			1	42		**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow silty SAND (SM), with some gravel	5		THER
	5		2	84 11"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow well-graded SAND with silt (SW-SM), with little gravel			
795			3	50 4"					
	10		4	50 5"			4		SA(9)
790									
	15		5	50 5"		Very dense, moist, brownish yellow, poorly-graded SAND (SP)	5	118	
785			6	50 5"			4		
						Bottom of boring at 18.7'			
	20								
780									
	25								

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Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring B-2** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	800 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38518, W: -117.23460		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
800	0					**Residual Soil** Shallow Fill (~1') over dense, moist, dark brown silty SAND (SM), with trace clay			
						Completely Weathered Granitic Rock excavates to: medium dense, moist, dark brown clayey SAND (SC), with trace fine gravel	12		WA(47)
			1	17					
795	5		2	83 11"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow silty SAND (SM), with some fine gravel			THER
			3	76 9"		Very dense, moist, brownish yellow, poorly-graded SAND (SP-SM) with silt	13		
790	10		4	50 3"					No Recovery
						Becomes light yellowish brown			
785	15		5	50 3"					No Recovery
			6	50 2"					No Recovery
						Bottom of boring at 18.5 feet			
780	20								
775	25								

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring B-3

Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	19.2 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38551, W: -117.23463		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Shallow Fill (~1') over dense, moist, dark brown clayey SAND (SC)			
		Bulk	1a						R-Value, COMP
			1	53			12	128	LL(40), PI(26), WA(28)
790						**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow clayey SAND (SC), with some fine gravel			
	5		2	88 10"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow Poorly-graded SAND (SP), with some fine gravel	8		
			3	50 4"		Becomes very pale brown	4	113	
785									
	10		4	84 10"			4		
780									
	15		5	93 9"			4	124	
			6	87 10"		Becomes dark grayish brown	4		
775						Bottom of boring at 19.2 feet			
	20								
770									
	25								

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring B-4

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	791 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38554 W: -117.23465		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
790	0					**Residual Soil** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC), with trace fine gravel			
			1	26		**Completely Weathered Granitic Rock** excavates to: medium dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
785	5		2	93 9"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow clayey SAND (SC)			THER
			3	83 11"			14		SA(43)
780	10		4	50 3"					No Recovery
775	15		5	50 3"		Very dense, moist, dark grayish brown Poorly-graded SAND (SP)	2		
			6	50 2"			2		
770	20					Bottom of boring at 18.5 feet			
	25								

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Figure A-5

Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring P-1** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	6.0 feet
Drill Rig Type	Marl M5, Truck mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings	Location	N: 33.38580, W: -117.23489		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC)			
		SPT	1	20					
790						**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
	5	SPT	2	42					
						Bottom of boring at 6 feet			
785	10								
780	15								
775	20								
770	25								

Report: GEO_10_SNA; File 60534181.GPJ; 2/27/2017 P-1

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Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring P-2** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	6.0 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings	Location	N: 33.38581, W: -117.23505		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil to Completely Weathered Granitic Rock** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC)			
		SPT	1	17					
790						**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
	5	SPT	2	65					
						Bottom of boring at 6 feet			
785	10								
780	15								
775	20								
770	25								

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Figure A-7

SDG&E Fallbrook Energy Storage Project, California
Percolation Test Data

P-1 (Basin)			Description		Boring Diameter	7	inches
					Boring Depth	6.00	feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
2/1/2017	Pre-soak	14:46	0	NA	NA	NA	NA
	add water						
2/2/2017	add water	9:32 AM	0	NA	NA	NA	NA
		10:09 AM	37	0.02	154.2	0.39	2.75E-04
		10:39 AM	30	0.02	125.0	0.48	3.39E-04
		11:16 AM	37	0.01	308.3	0.2	1.37E-04
	add water	11:38 AM	22	NA	NA	NA	NA
		12:10 PM	32	0.01	266.7	0.2	1.59E-04
		Average (last two) readings =			287.5	0.21	1.48E-04

P-2 (Basin)			Description		Boring Diameter	7	inches
					Boring Depth	6.00	feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
2/1/2017	Pre-soak	14:54	0	NA	NA	NA	NA
	add water						
2/2/2017	add water	9:34 AM	0	NA	NA	NA	NA
		10:07 AM	33	0.01	275.0	0.22	1.54E-04
		10:43 AM	36	0.00	#DIV/0!	#DIV/0!	#DIV/0!
		11:22 AM	39	0.00	#DIV/0!	#DIV/0!	#DIV/0!
	add water	11:34 AM	12	NA	NA	NA	NA
		12:14 PM	40	0.01	333.3	0.18	1.27E-04
		Average (last two) readings =			304.2	0.2	1.40E-04

Infiltration Rate
Per Porchet Method

P-1: H_{avg} = 33.3 inches
I = 0.0097 in/hr Slowest Reading

P-2: H_{avg} = 41.34 inches
I = 0.0073 in/hr Slowest Reading

Porchet Method Calculation Example

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$

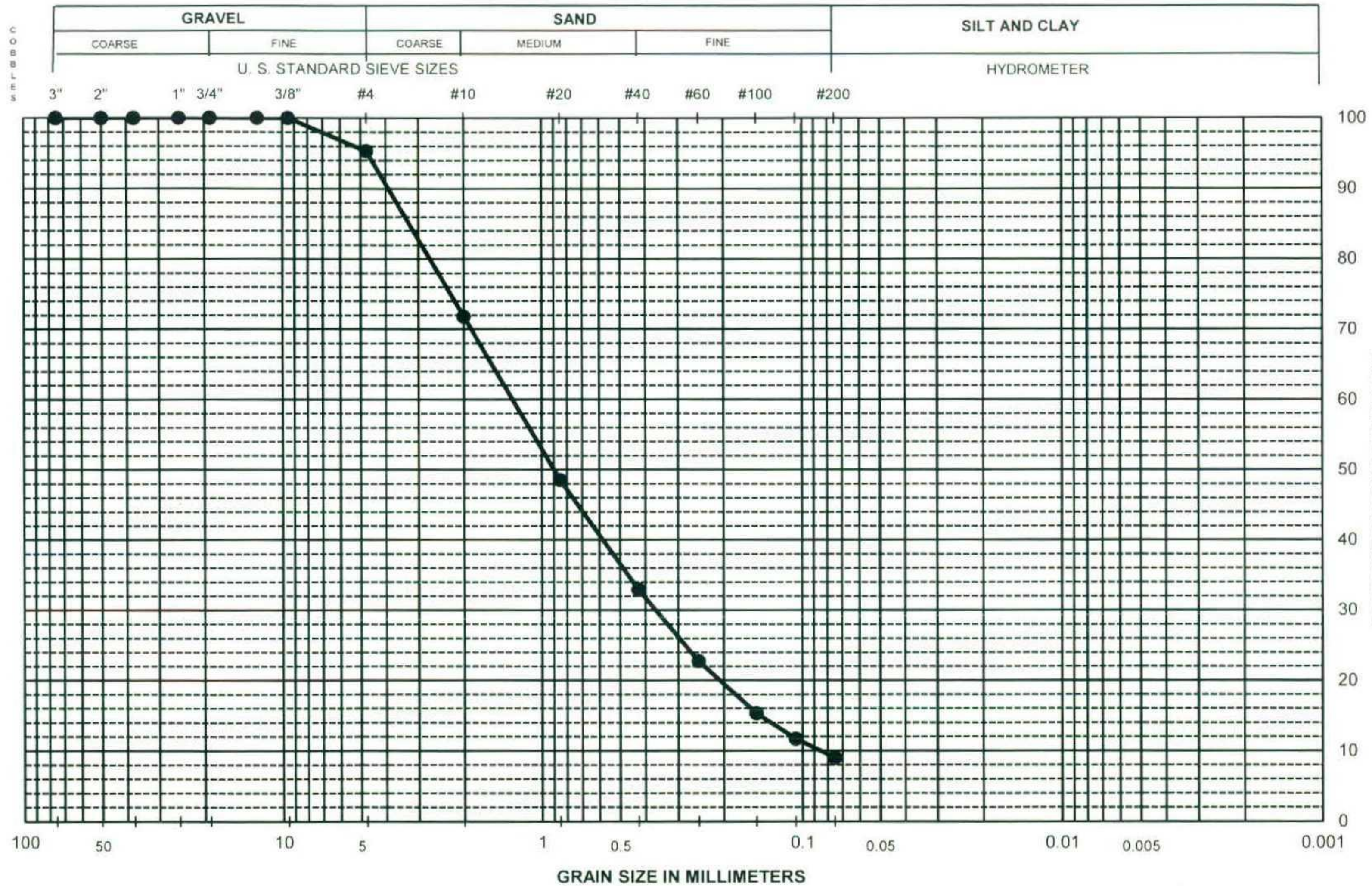
Havg - Height of last 2 readings
r - radius of boring

ΔH = 0.06 ft = 0.72 in
r = 3.5 inches
Δt = 30 min
H_{avg} = 3.84 in

Figure A-8

Geotechnical laboratory testing was performed in general accordance with ASTM standards. Results of laboratory testing performed are presented in this appendix. The results of moisture content and fines content are shown at the corresponding sample locations on the boring logs in Appendix A.

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	95.3
#10	2.00	71.8
#20	0.850	48.5
#40	0.425	32.9
#60	0.250	22.7
#100	0.150	15.3
#140	0.106	11.7
#200	0.075	9.0
Hydrometer Analysis		

% Cobbles	0.0
% Gravel	4.7
% Sand	86.3
% Fines	9.0
D_{85}	3.251
D_{60}	1.297
D_{50}	0.898
D_{30}	0.365
D_{15}	0.146
D_{10}	0.085
C_u	15.2
C_c	1.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-1	4	10.0	●	3.5	---	---	---	**Brownish yellow Well Graded SAND with Silt (SW-SM)**

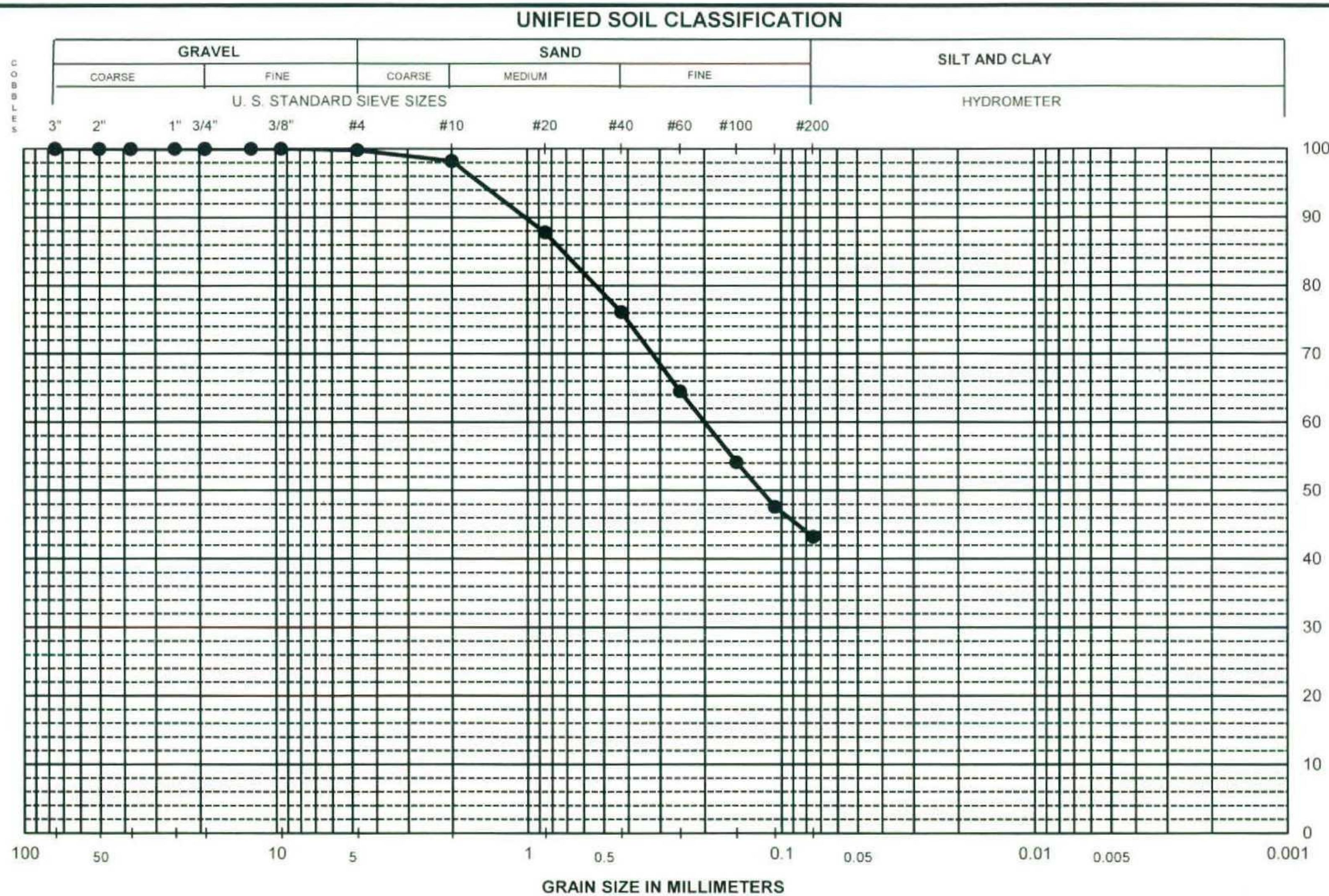
PROJECT NAME: SDG&E Fallbrook Substation

PROJECT NUMBER: 60534181

PARTICLE-SIZE DISTRIBUTION CURVES

U:\Projects_Jobs\60534181_Casteel\400-Technical\440-Field and Laboratory Data\Lab Testing\Sieve SDG&E Fallbrook SubS B-1 10 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	99.8
#10	2.00	98.2
#20	0.850	87.8
#40	0.425	76.1
#60	0.250	64.5
#100	0.150	54.1
#140	0.106	47.6
#200	0.075	43.2
Hydrometer Analysis		

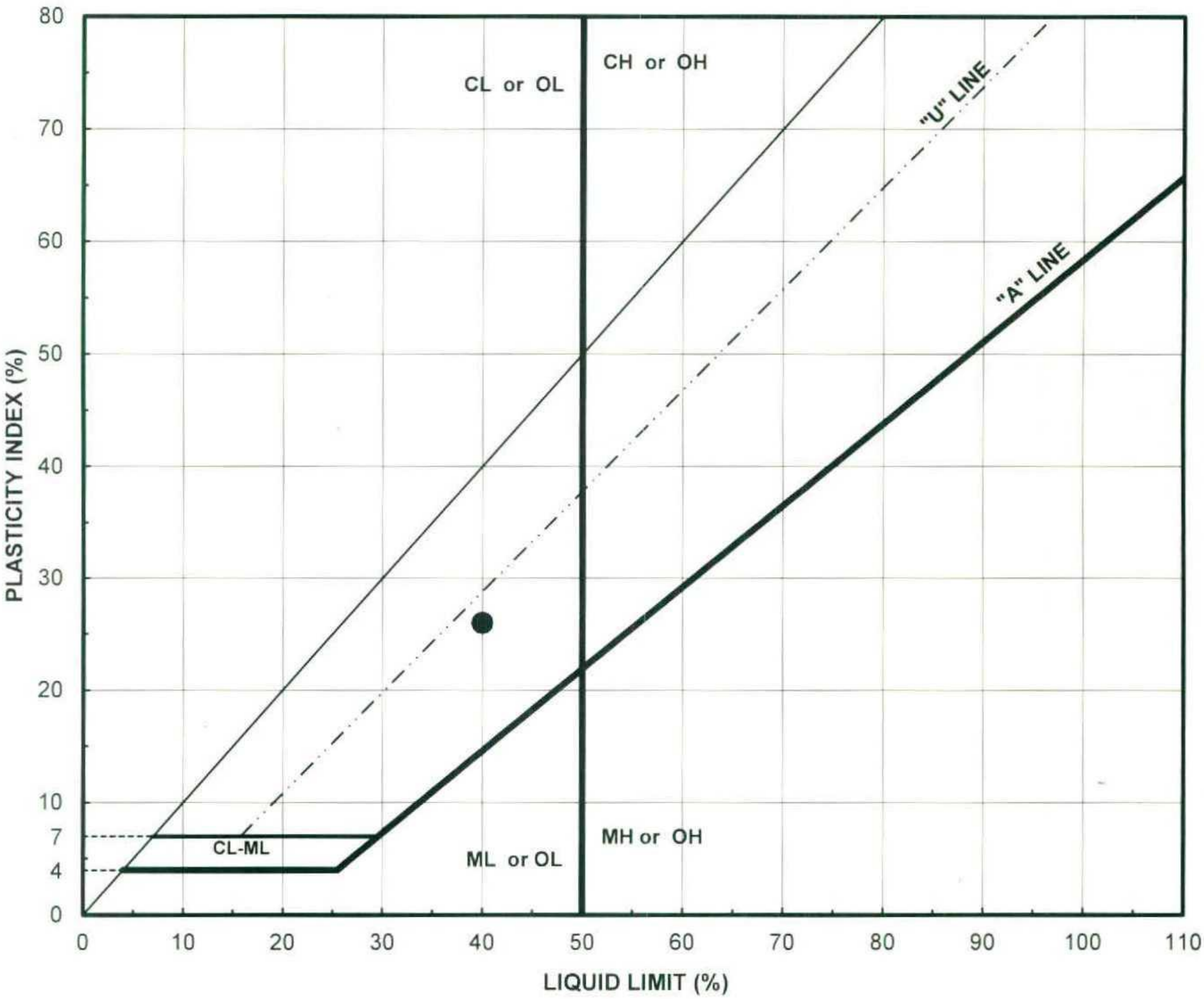
% Cobbles	0.0
% Gravel	0.2
% Sand	56.6
% Fines	43.2
D_{85}	0.720
D_{60}	0.200
D_{50}	0.120
D_{30}	#N/A
D_{15}	#N/A
D_{10}	#N/A
C_u	----
C_c	-----

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B-4	3	7.5	•	14.3	---	---	---	**Brownish yellow Clayey SAND (SC)**

PROJECT NAME: SDG&E Fallbrook Substation

PROJECT NUMBER: 60534181

PARTICLE-SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (ft)	Water Content (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B-3	1	2.5	12.0	40	26	Brownish yellow Clayey SAND (SC)

Project Name: SDG&E Fallbrook Substation **PLASTICITY CHART**

Project Number: 60534181

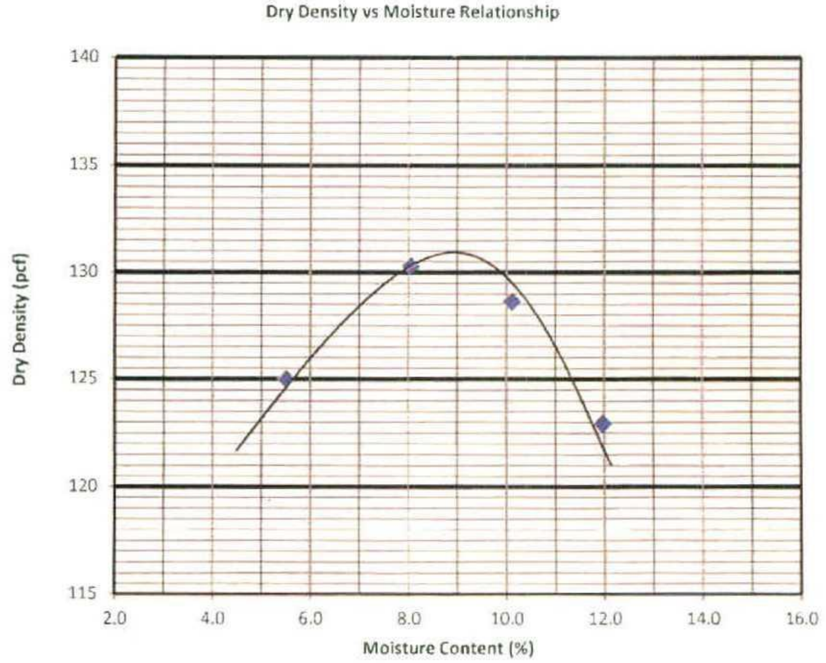
REPORT OF MOISTURE/DENSITY RELATIONSHIP TEST

(ASTM D1557/D698)

Date:	February 16, 2017	Job Number:	891
Client:	URS Corporation (San Diego, CA)	Report Number:	4803
Address:	P.O. Box 203970	Lab Number:	113843
	Austin, Texas		

Project:	Fallbrook Substation		
Project Address:	Fallbrook, California		
Material:	Brown silty SAND (SM)	Mold Size:	4 inch
Material Source:	Native		
Location:	Bulk 1 (1'-2')	ASTM D1557	A
Date Sampled:	2/10/2017		
Date Submitted:	2/10/2017		
Sampled By:	PB		

Maximum Dry Density = 131.0 pcf **Optimum Moisture = 9.0%**



Distribution

Client

File

Reviewed By: ____________

Sam Koohi, PE

Engineering Manager

NV5

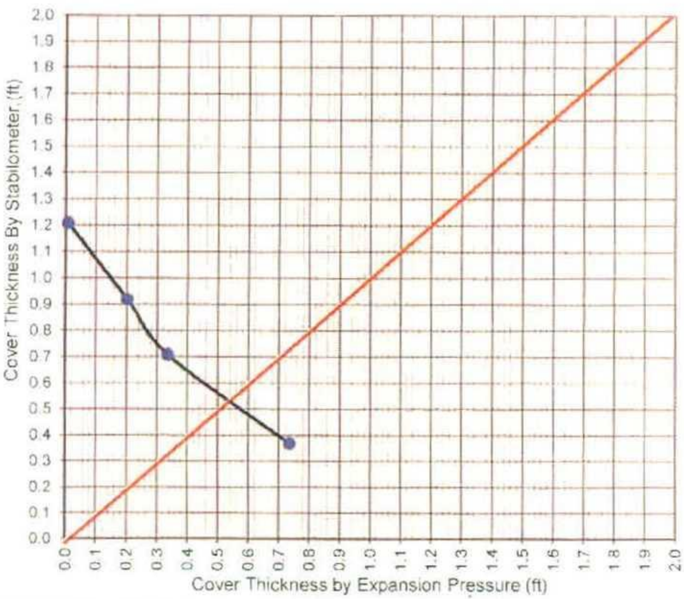
RESISTANCE "R" VALUE TEST

(CTM301 Caltrans / ASTM D2844)

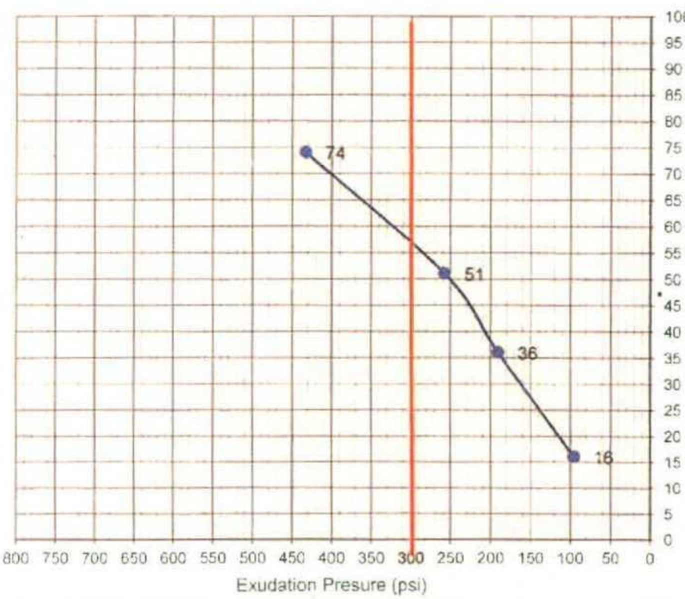
Date:	2/16/2017	Job Number:	891
Client:	URS Corporation (San Diego, CA)	Report Number:	4803
Address:	P.O. Box 203970 Austin, Texas	Lab Number:	113843
Project :	Fallbrook Substation		
Project Address :	Fallbrook, California		

Material:	Brown silty SAND (SM)
Material Source:	Native
Location:	Bulk 1 (1'-2')
Sampled By:	PB
Date Sampled:	2/10/2017
Date Received:	2/10/2017

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



TEST SPECIMEN	A	B	C	D
COMP. FOOT PRESSURE, psi	350	350	275	70
INITIAL MOISTURE %	6.7	6.7	6.7	6.7
MOISTURE @ COMPACTION %	10.3	11.1	12.0	13.8
DRY DENSITY, pcf	124.8	124.8	123.1	120.6
EXUDATION PRESSURE, psi	433	258	191	96
STABILOMETER VALUE 'R'	74	51	36	16

R-VALUE BY EXUDATION	57
R-VALUE BY EXPANSION	64
R-VALUE AT EQUILIBRIUM	**57**

Respectfully Submitted,
NV5 West, Inc.

Sam Koohi, PE
Engineering Manager

Table 1 - Laboratory Tests on Soil Samples

AECOM
SDGE Fall Break
Your #60534181.100, HDR Lab #17-0109LAB
23-Feb-17

Sample ID			B-2, S-3 @ 7.5' SM
Resistivity		**Units**	
as-received		ohm-cm	19,600
minimum		ohm-cm	1,560
pH			7.7
Electrical Conductivity		mS/cm	0.15
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	11
magnesium	Mg^{2+}	mg/kg	6.6
sodium	Na^{1+}	mg/kg	158
potassium	K^{1+}	mg/kg	3.1
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	85
fluoride	F^{1-}	mg/kg	4.9
chloride	Cl^{1-}	mg/kg	46
sulfate	SO_4^{2-}	mg/kg	176
phosphate	PO_4^{3-}	mg/kg	ND
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	16
sulfide	S^{2-}	qual	na
Redox		mV	na

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Attn:	Pallavi Balasubramanyam
Client Name:	URS Corporation

Project: Fallbrook Substation (URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

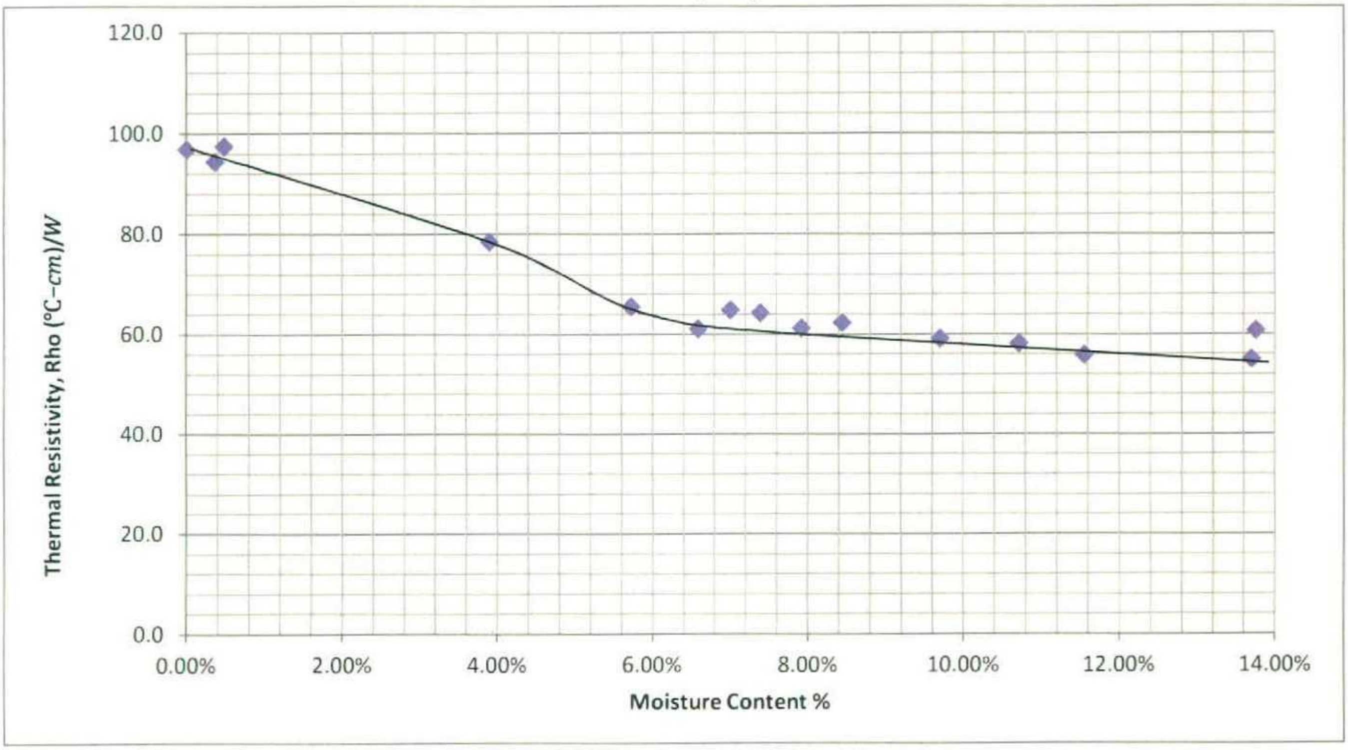
Test Material Description: Brown silty CLAY (CL)
Test Material ID: B-1 @ 2.5'
Sample Date: 2/01/17 Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	109.7	Field Moisture (%)	13.7
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	96.8	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	78

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

Attn: Pallavi Balasubramanyam
Client Name: URS Corporation

NV5

Project: Fallbrook Substation
(URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

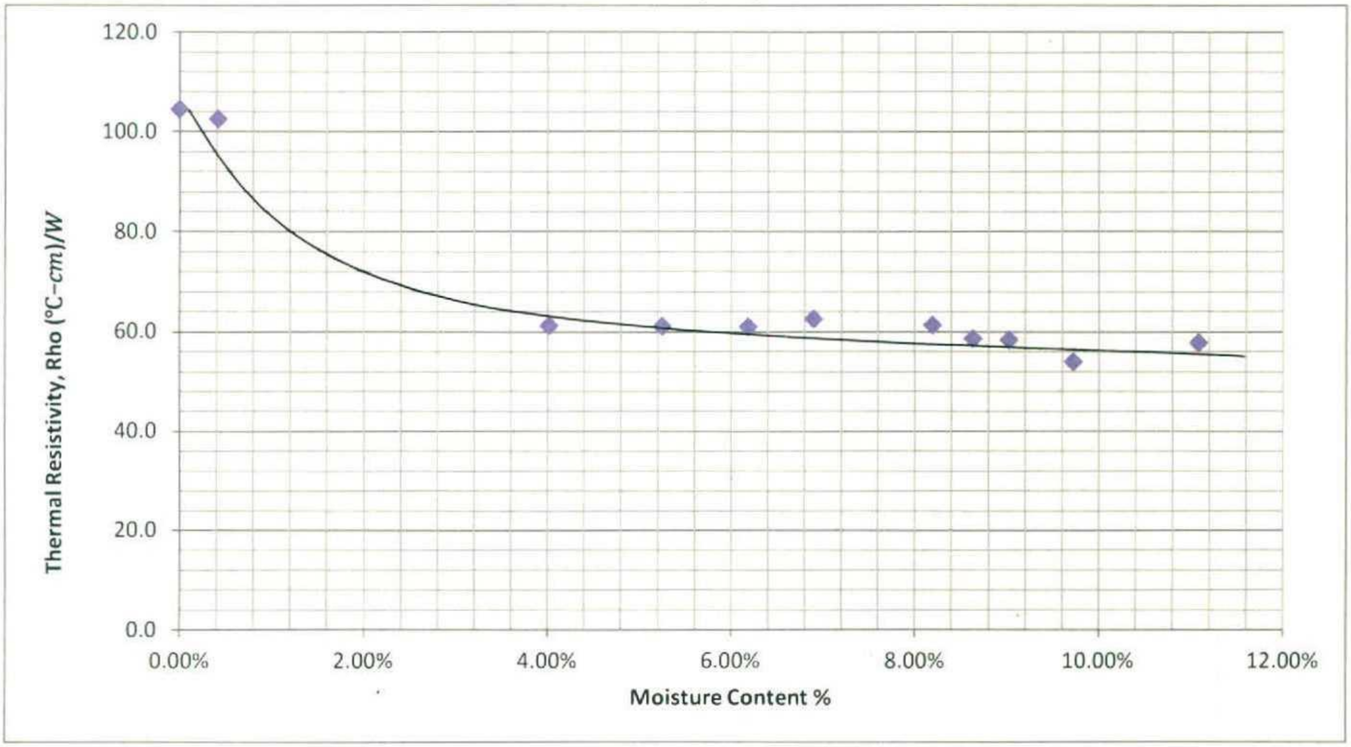
Test Material Description: Tan Brown silty SAND (SM-SP)
Test Material ID: B-2 @ 5'
Sample Date: 2/01/17 Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	116.5	Field Moisture (%)	8.6
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	104.5	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	62

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

Attn:	Pallavi Balasubramanyam
Client Name:	URS Corporation

Project: Fallbrook Substation
(URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

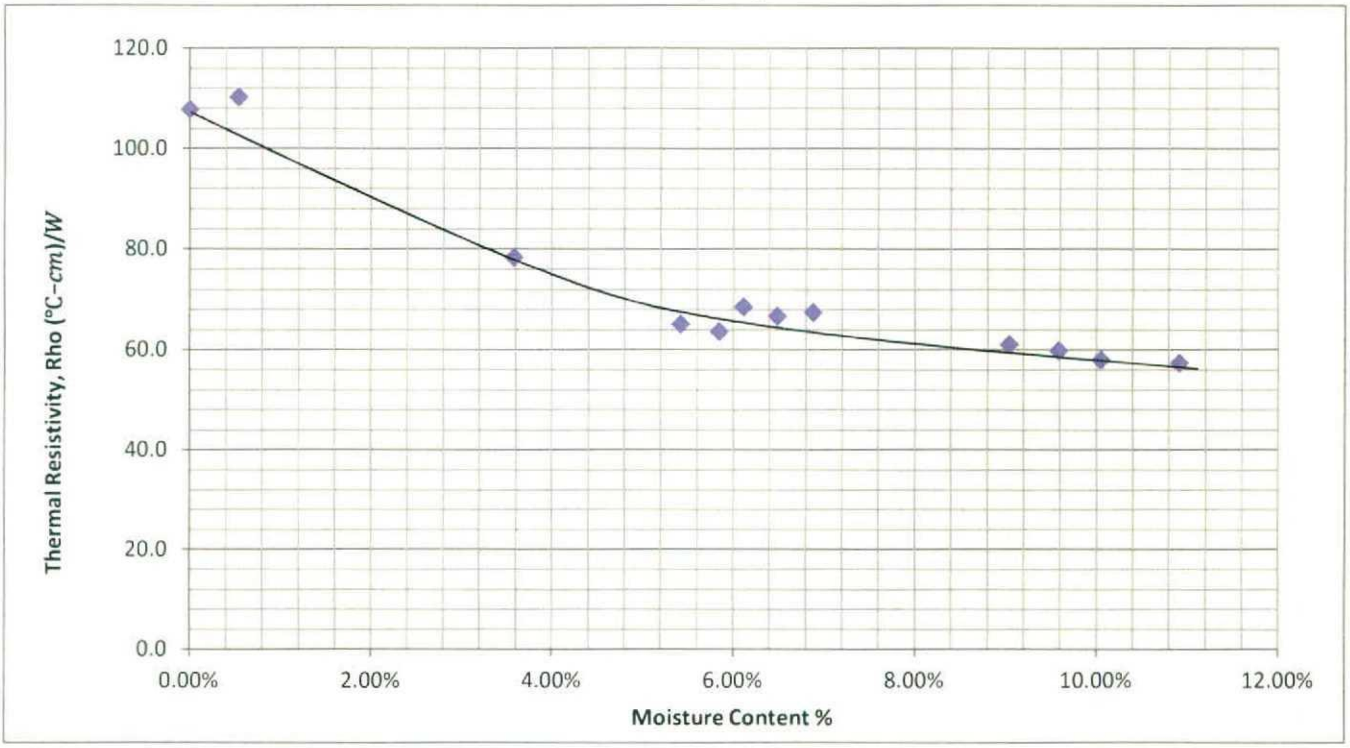
Test Material Description: Tan Brown silty SAND (SM-SP)
Test Material ID: B-4 @ 5'
Sample Date: 2/01/17 Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	114.5	Field Moisture (%)	10
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	107.8	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	75

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

REPORT

GEOTECHNICAL INVESTIGATION SAN DIEGO GAS & ELECTRIC FALLBROOK BATTERY STORAGE PROJECT; PARCEL 2 FALLBROOK, CALIFORNIA

Prepared for

Mr. David Heard
AES Energy Storage
4300 Wilson Boulevard
Arlington, VA 22203

AECOM Project No. 60544320.10000

October 30, 2017

AECOM

401 West A Street, Suite 1200
San Diego, CA 92101
619-610-7600 Fax: 619-610-7601

AECOM

October 30, 2017

Mr. David Heard
AES Energy Storage
4300 Wilson Boulevard
Arlington, VA 22203

Subject: Geotechnical Investigation
San Diego Gas & Electric
Fallbrook Battery Storage Project; Parcel 2
Fallbrook, California
AECOM Project No. 60534181

Dear Mr. Heard:

AECOM Technical Services, Inc. is providing this draft geotechnical report for the above-referenced project in accordance with our proposal dated May 8, 2017. AECOM previously performed a geotechnical investigation for Casteel Corporation at the originally considered parcel, located north of the referenced Parcel 2. This geotechnical report provides the findings from the previous investigation as well as the subsurface explorations performed for this investigation, a discussion of geologic and geotechnical conditions, and geotechnical recommendations for design and construction of the project.

If you have any questions regarding this report, or if we can be of further service, please contact us.

Sincerely,

AECOM Technical Services, Inc.

REGISTERED PROFESSIONAL ENGINEER STEVEN M. FITZWILLIAM 2501 EXP. 6/30/19 GEOTECHNICAL STATE OF CALIFORNIA

Steven M. Fitzwilliam, G.E. 2501
Principal Geotechnical Engineer

CERTIFIED ENGINEERING GEOLOGIST DEREK RECTOR No. 2635 Exp. 10/31/19 STATE OF CALIFORNIA

Derek R. Rector, C.E.G. 2635
Project Engineering Geologist

Pallavi Kumar, P.E. 78540
Project Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER PALLAVI KUMAR C-78540 EXP. 09/30/19 CIVIL STATE OF CALIFORNIA

AECOM
401 West A Steet, Suite 1200
San Diego, CA 92101
Tel: 619.610.7600
Fax: 619.610.7601

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SECTION 1 INTRODUCTION

This report presents the results of AECOM Technical Services, Inc. (AECOM) geotechnical investigation for the proposed San Diego Gas & Electric Company (SDG&E) Battery Storage Project (Project) in Fallbrook, California. The Project site is located south of East Mission Road as shown on Figure 1. This report has been prepared exclusively for AES Energy Storage (AES) and their consultants for planning and design of the referenced project.

1.1 PROJECT DESCRIPTION

AECOM previously prepared a geotechnical investigation for a parcel north of the current site (Parcel 1) and presented the results in a report dated February 27, 2017. That investigation was performed for Casteel Corporation. We understand AES is considering a second parcel (an existing vacant lot) identified as Parcel 2 for the location of the Project, as shown on Figure 2. A site plan was not available at the time this report was prepared. However, based on our previous understanding, we anticipate the Project may consist of approximately 30 battery storage modular core containers that may be housed in a warehouse building, a main transformer, fifteen (15) isolation transformers, and an auxiliary transformer. We further anticipate the equipment will be supported on shallow mat/pad foundations and the building may be supported on continuous footings.

Infiltration basins are planned for the Project to comply with the County of San Diego stormwater regulations. Based on the site topography, we expect the basin(s) will be located at either the northwest or southeast corners of the site.

We understand the Project is being designed by a joint venture between AES and Casteel Corporation, the Engineer, Procure, Construct (EPC) Contractor. The engineering recommendations presented in this geotechnical investigation report are suitable for Project design and construction.

1.2 SCOPE OF SERVICES

The purpose of our services was to evaluate the subsurface conditions at the site and perform preliminary geotechnical analyses to provide recommendations for design and construction of the proposed improvement. The scope of services included the following tasks:

- Performing a site reconnaissance and boring location mark out;
- Coordinating utility clearance through Underground Services Alert (USA);
- Engaging subcontractors to complete geotechnical borings and in-situ electrical resistivity testing;
- Performing in-situ percolation testing and laboratory compaction tests on two near-surface samples;
- Evaluating subsurface conditions (including soil and groundwater) at the site;
- Preparing engineering recommendations for the design and construction of the structure foundations, including bearing capacity, vertical subgrade modulus, and lateral resistance parameters;

- Developing of seismic design parameters in accordance with the California Building Code (CBC);
- Discussing earthwork/trenching considerations; and
- Preparing this geotechnical report.

The geotechnical field investigation and laboratory testing performed as part of the geotechnical investigation for the adjacent Parcel 1 are included here.

SECTION 2 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included reviewing published geologic information, as well as performing additional subsurface explorations, infiltration testing, and geotechnical and electrical resistivity laboratory testing.

2.1 PREVIOUS INVESTIGATION

AECOM performed a geotechnical exploration program for the parcel located north of the current site (Parcel 1) in January 2017. The field explorations for that investigation consisted of advancing four (4) geotechnical borings to a depth of about 19 feet below ground surface (bgs), and performing percolation tests in two shallow explorations at a depth of about 5 feet bgs. The locations of these explorations are shown on Figure 2 and the logs of the previous explorations and percolation test data are presented in Appendix A.

Laboratory testing performed for the previous investigation is also presented in Appendix A. The materials encountered in Parcel 1 borings were visually classified and evaluated with respect to relative density or consistency and moisture content. The samples from the borings advanced on Parcel 1 were returned to our geotechnical laboratory for further examination and testing as part of our previous investigation. The visual classifications were further evaluated by performing moisture content, unit weight, Atterberg Limits tests and grain size analyses. The shear strength of the soil was evaluated by correlating with the blow count and index test results. The pavement subgrade strength was evaluated by performing an R-Value test. Corrosion potential of the near-surface soil was also evaluated. Testing was performed in general accordance with ASTM International (ASTM) or other relevant standards.

Thermal resisitiviy testing of the subsurface materials was performed on select soil samples from the upper 5 feet of the surface. Thermal resistivity tests were performed at various moisture contents in compliance with IEEE 442 specifications by our subcontractor, NV5. Test results from the NV5 laboratory testing along with the corresponding thermal dryout curves are included in Appendix A.Results of the geotechnical laboratory testing are presented at the corresponding sample locations on the boring logs.

2.2 FIELD INVESTIGATION AND LABORATORY TESTING

Our geotechnical field investigation included two (2) exploratory borings, four (4) in-situ percolation tests and two (2) in-situ electrical resistivity tests. The explorations were extended to depths ranging from 5 to 10 feet bgs. The borings were advanced on May 15, 2017 and the percolation testing was completed in Borings P-1 through P-4 on May 16, 2017. The locations of the explorations performed on Parcel 2 are shown on the Site Plan (Figure 2).

The borings were advanced with a truck mounted drill rig using hollow-stem augers. Drive samples were collected in the geotechnical borings B-1 and B-2 during the drilling program. An AECOM geotechnical engineer supervised the drilling activities, logged and sampled the explorations and performed the percolation testing. Two near-surface bulk samples were also collected from Parcel 2 to perform laboratory compaction tests.

The exploratory program is discussed further in Appendix B, which also presents the logs of the explorations. The descriptions on the logs are based on field logging and laboratory testing. Laboratory testing (except for the compaction tests mentioned above) was not performed on the samples collected from the current explorations, since the materials encountered in the current explorations were similar to those advanced in Parcel 1. Laboratory testing was included in the borings on the adjacent Parcel 1 and is considered applicable to Parcel 2. Laboratory compaction test results are included in Appendix B.

Testing to evaluate the infiltration characteristics of the subsurface was performed in Borings P-1 through P-4, which extended to depths of 5 feet bgs. Borings P-1 and P-2 were located in the northwest corner of the site, and P-3 and P-4 were located in the southeast corner of the site. Percolation testing was performed in general accordance with the testing procedure outlined by the County of San Diego, Department of Environmental Health guidelines titled "Design Manual for Onsite Wastewater Treatment Systems, County of San Diego Department of Environmental Health, Land and Water Quality Division," March 22, 2010 (Updated November 25, 2013). The summarized test data is presented in Section 5.5 below. Complete tables of data collected are presented in Appendix B.

Electrical resistivity soundings were completed in accordance with ASTM)G57-06. Resistivity measurements were made using two (2) Wenner Arrays as shown on the Site Plan, Figure 2. Detailed report presenting the methodology and the results of the survey are provided in Appendix B.

SECTION 3 GEOLOGIC AND SITE CONDITIONS

Knowledge of the site conditions was developed from a review of the local geology, available information and current subsurface explorations.

3.1 GEOLOGIC SETTING

The project site is in the Peninsular Ranges geomorphic province and lies along the western margin of the foothills sub-province. The foothills sub-province is underlain by Cretaceous granitic rock and Jurassic age metavolcanic rocks overlain with Quaternary age alluvium, alluvial fans and valley fill deposits in the low lying areas.

The proposed battery storage Project area is underlain by variably weathered granitic rock. The ground surface in the Project area has been slightly modified for agricultural purposes. The site lies just south of a broad drainage area that is underlain by alluvial deposits. A Regional Geologic map on a topographic base is presented as Figure 3.

3.2 TECTONIC AND SEISMIC SETTING

The Project site, and southern California in general, lie in an active tectonic region. At the latitude of the study area, the interaction between the North American and Pacific plates is considered to take place across a wide area, extending from the San Andreas fault zone in the Imperial Valley to the east, to tens of miles offshore to the west.

The main fault zones are predominantly northwest trending right-lateral strike-slip faults. Other significant faults include northeast-trending left-lateral strike-slip conjugate faults, and locally, east-west trending reverse faults, and blind thrust faults.

To the west of the San Andreas fault zone, other main faults include the San Jacinto fault zone, Whittier-Elsinore fault zone, Newport-Inglewood-Rose Canyon fault zone and a complex zone of branching and stepping northwest-trending offshore faults. The major active faults closest to the site are the Oceanside section of the Newport-Inglewood-Rose Canyon fault zone located in the offshore zone to the west and the Elsinore fault zone located to the east. Active faults located farther offshore include the Palos Verdes-Coronado Bank fault zone and the San Diego Trough fault zone.

The active faults (i.e. Holocene-age fault rupture) and potentially active (i.e. Quaternary-age fault rupture) faults are shown on the Regional Fault and Epicenter Map, Figure 4.

The Temecula section of the active Elsinore fault zone lies approximately 8 miles to the east of the site. In the proximity of the Temecula section are the Wolff Valley fault and Murrietta Creek fault. The estimated maximum moment magnitude (Mw) of a seismic event on the Temecula section of the Elsinore fault zone ranges from 6.8 to 7.0. Larger magnitudes are possible if multiple faults in the area rupture in a single event with potential maximum moment magnitudes (Mw) ranging from 7.7 to 7.8 (USGS, 2008).

The Newport-Inglewood-Rose Canyon fault zone and the known active strands along the Oceanside section of the zone are located approximately 18 miles west of the site. Based on the USGS Quaternary fault and fold database website of National Seismic Hazard Maps, the estimated maximum moment magnitude (M_w) of a seismic event on the Newport-Inglewood-Rose Canyon fault zone ranges from 6.7 to 6.9 (USGS, 2008). Larger earthquake events may be possible if multiple segments of these fault zones rupture in a single event

3.3 SURFACE CONDITIONS

The site area is currently a moderately to heavily vegetated vacant lot. We understand the site was previously used as agricultural land. The ground surface elevation of the Project area grades from approximately +825 feet to +797 feet Mean Sea Level (MSL), with the center of the site being at the highest elevation and gently sloping down towards the northwestern and southeastern corners of the site. For engineering design considerations we have developed a four layer soil profile as presented in Section 5.2.1 and consisting of; engineered fill (see recommendations in earthwork section below), residual soil, completely weathered rock, and highly weathered rock. The recommended design parameters and associated depths for each profile layer are presented in Table 1 in Section 5.2.1.

3.4 SUBSURFACE CONDITIONS

The evaluations of subsurface conditions for the Project have been based on the borings performed for the previous investigation (Parcel 1), this investigation, and our review of available geologic information. The subsurface consists of surficial fill / topsoil and residual soil underlain by weathered granitic rock. These units are described below.

3.4.1 Fill / Residual Soil

Our explorations encountered shallow fill (interpreted to be disturbance caused by the previous agricultural activities) over residual soil. These surficial units, which extended to depths of 2 to greater than 5 feet bgs, were observed to consist of silty to clayey sand.

3.4.2 Granitic Rock

The Project site is underlain by variably weathered granitic rock. The rock is completely to highly weathered to the maximum explored boring depths. The weathered rock typically excavates to well-graded sand to silty or clayey sand with some gravel and generally behaves as a medium dense to very dense soil.

A potentially significant construction consideration in this granitic rock setting is that even within the zone of completely or highly weathered rock (generally rippable conditions based on recent drilling information), there is a potential for less weathered rock to occur in localized zones that could result in marginally rippable or non-rippable conditions. These hard rock zones are sometimes referred to as core stones or "floaters" and can result in more difficult excavation conditions than in adjacent areas.

3.5 GROUNDWATER

A permanent groundwater surface was not encountered in the current explorations. Groundwater is anticipated to be greater than 25 feet bgs. Localized perched groundwater conditions may exist underlying the site.

SECTION 4 SEISMIC AND GELOGIC HAZARDS

This section presents our evaluations of the seismic and geologic hazards at the site based on review of available geologic information, the results of our current investigation, engineering evaluations and analyses, and professional judgment.

4.1 FAULT RUPTURE

The potential for surface fault rupture at the site is considered to be very low. The site is not located within California Geological Survey (CGS) Fault-Rupture Hazard Zones (Alquist-Priolo Earthquake Fault Zones). There are no active or potentially active faults within the site area based on regional geologic mapping and our investigations. The nearest active fault to the site is the Elsinore fault zone located approximately 8 miles east of the site. This fault is not considered to present a significant fault rupture hazard in the site area.

4.2 LIQUEFACTION AND SECONDARY EFFECTS

Liquefaction is a phenomenon in which loose to medium dense, saturated, granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength because of cyclic ground vibrations induced by earthquakes or other ground vibrations. This rearrangement and strength loss is followed by a reduction in bulk volume of the liquefied soils. The secondary effects of liquefaction include sand boils, settlement, reduced soil shear strength, lateral spreading and global instability (flow slides in areas with sloping ground).

The project site is predominately underlain by variably weathered dense to very dense granitic rock. Further, groundwater is expected to occur at depth within the fractured granitic rock. Therefore, the potential for liquefaction at the site should be very low.

Strong ground motion can cause the densification of soils, resulting in settlement of the ground surface. This phenomenon is known as seismically-induced settlement or seismic compaction, which typically occurs in dry, loose cohesionless soils. During an earthquake, soil grains may become more tightly packed due to the collapse of voids or pore spaces, resulting in a reduction in the thickness of the soil column. Given the dense to very dense nature of the subsurface materials, the potential for seismic compaction at the site is considered low.

4.3 LANDSLIDES AND SLOPE STABILITY

We expect the grading activities at the site will flatten the site to be relatively level and the existing slopes are gradual slopes. Therefore, the potential for landsliding to impact the Project is considered to be low.

4.4 EXPANSION AND COLLAPSE POTENTIAL

The on-site fill/topsoil and residual soil as well as the granitic rock weathering are predominately silty to clayey sand with a relatively low plasticity. Excessive swelling or shrinkage of the surficial soil/rock due to wetting and drying over time is not anticipated. The potential for expansive soil to impact performance of the proposed improvements is considered low.

Loose granular soils can be subject to collapse due to wetting and/or inundation. Collapse can occur in dry granular soils that have an unstable soil structure due to deposition or irrigation processes, typically with a skeletal structure that is weakly cemented by soluble salts or clay. Increases in moisture content can cause the interparticle cementation to reduce, causing changes in volume (collapse), especially when loaded. The native soils are primarily derived from weathering of the native granitic rock. Therefore, the potential for collapse at the site is considered low.

4.5 SETTLEMENT

The proposed improvements will be supported on shallow foundations. The soil and weathered granitic rock that will underlie the shallow foundations for the proposed improvements is medium dense to very dense. The estimated settlement has been evaluated with respect to the anticipated loads and has been incorporated in the engineering design. The potential for excessive settlement affecting the proposed development is low.

4.6 OTHER HAZARDS

The local geologic conditions indicate that other geologic hazards are not likely to affect the site. Given the geologic and hydrogeologic setting of the site, the potential for subsidence is very low. Given the location and relative elevation of the site, the potential for seiches or tsunamis affecting the site is considered very low. Similarly, the site is not located within a designated flood plain and the flood hazard is considered low. These hazards should not constitute constraints to proposed improvements.

SECTION 5 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

The discussions, conclusions, and recommendations presented in this report are based on the information provided to us, results of current subsurface explorations and laboratory testing, engineering evaluations and analyses, literature research, empirical correlations, and professional judgment.

The subsurface conditions at the site are suitable for the proposed development, provided the recommendations presented in this section are incorporated into the design and construction.

5.1 EARTHWORK

Earthwork should be completed according to SDG&E Standard Specifications, the most recent editions of applicable sections of the County of San Diego grading codes, and the Standard Specifications for Public Works Construction (*i.e.,* Greenbook). The following sections provide further recommendations for general earthwork that are specific to the geotechnical conditions encountered. Due to the existing site topography and the proposed site improvements, earthwork for the project is anticipated to be minimal.

5.1.1 Site Preparation

Roots and other vegetative matter, should be removed and disposed either offsite or stockpiled for reuse in landscape areas. Existing infrastructure, if any, should be properly demolished and disposed at an appropriate facility offsite. Any other soil areas disturbed by the demolition should be removed and recompacted or replaced with non-expansive fill to the satisfaction of the Geotechnical Engineer.

Existing shallow fill and residual soils are not considered suitable for the support of the proposed improvements and therefore should be removed to a depth of 3 feet below the bottom of the foundations, slabs-on-grade and pavements and replaced as engineered fill. It is recommended that the proposed foundations, slabs-on-grade and pavements should be supported on engineered fill or completely weathered rock. Upon completion of removals, the surface within areas to receive fill should be scarified, moisture conditioned as necessary, and compacted prior to fill placement. Areas temporarily vacated during earthwork should be similarly scarified, moisture conditioned and reworked to the satisfaction of a Geotechnical Engineer before placing additional fill to avoid drying out and lamination along the fill interface. Localized deeper soft soils that may be identified during subgrade exposure should be locally removed and replaced with engineered fill. A geotechnical professional should make the final determination of actual removal depths in the field during earthwork.

5.1.2 Fill Materials

Any fill or backill used for the Project should consist of select fill. Most of the onsite material is anticipated to be suitable for use as select fill, otherwise Class 2 Aggregate Base, or another quarried or natural source, could be used. Select fill should meet the following criteria:

- Contain no rocks or hard lumps greater than three inches in maximum dimension;

- Have a well-graded particle size distribution containing at least 40% of material smaller than ¼ inch in size, and a fines content (percent, by weight, passing the No. 200 sieve) less than 35%.
- Have an Expansion Index of 30 or less when tested in accordance with ASTM D4829; and
- Not have any perishable, spongy, deleterious or otherwise unsuitable material.

The Geotechnical Engineer should review and test all proposed fill sources before their use.

5.1.3 Fill Placement and Compaction

Fill material should be moisture conditioned to achieve a uniform moisture that is above the optimum moisture content. Fill material should be placed in loose lifts no thicker than eight inches, or thinner as needed to achieve the specified relative compaction. Each lift should be compacted to not less than 90 percent relative compaction, using the latest version of ASTM D1557 as the compaction standard. Any fill within the upper two feet of finished grade should be compacted to not less than 95 percent relative compaction.

5.2 FOUNDATIONS

We anticipate that mat/pad type shallow foundations will be used to support the new facility structures (modular core containers and main, auxillary and isolation transformers) outside of the Battery Storage Array Warehouse and the warehouse will be supported on continuous footings. AECOM has not been provided with the preliminary foundation sizes.

Based on the expected foundation types described above, we have performed engineering evaluations for shallow foundation support for the proposed battery storage facility structures. The recommendations provided herein may be used in the design of the foundations for the Project.

5.2.1 Subsurface Soil Profile

We have developed a subsurface soil profile to define soil parameters for use in foundation design. The design parameters presented below are intended for use in foundation design and may not reflect actual soil properties. Actual subsurface conditions in the field may vary. We recommend a subsurface soil profile consisting of engineered fill from 0 to 3 feet bgs underlain by residual soil from 3 to 6 feet bgs. The residual soil is underlain by completely weathered granitic rock from 6 to 10 feet bgs over highly weathered granitic rock below 10 feet. Groundwater can be assumed to be below a depth of 25 feet. The following soil parameters indicated in Table 1 may be used.

Table 1
Subsurface Soil Profile
Fallbrook Battery Storage Project

Strata	Depth (feet)	Soil Classification	Friction Angle, Φ (degrees)	Cohesion, c (psf)	Unit Weight, γ (pcf)
Engineered Fill	0-3	Silty/Clayey Sand, SC/SM	33	0	120
Residual Soil	3-6	Silty/Clayey Sand, SC/SM	30	0	120
Completely Weathered Granitic Rock	6-10	Clayey Sand, SC	35	0	125

Strata	Depth (feet)	Soil Classification	Friction Angle, Φ (degrees)	Cohesion, c (psf)	Unit Weight, γ (pcf)
Highly Weathered Granitic Rock	>10	Silty Sand, SM	38	0	130

Note:

1. psf – pounds per square foot.
2. pcf – pounds per cubic foot.

5.2.2 Allowable Bearing Pressure

All footings should bear on engineered fill or on undisturbed completely weathered rock and should be embedded at least 18 inches below lowest adjacent grade and should be at least 24 inches wide. The foundations supported on engineered fill or undisturbed completely weathered rock may be designed for an allowable bearing pressure of 3,000 or 4,500 pounds per square foot (psf), respectively. The footings should be fully embedded in engineered fill or undisturbed weathered rock and should not transition between fill and formational soils/weathered rock. A one-third increase may be applied to the allowable bearing pressure for temporary wind and seismic loading. Adjacent footings founded at different elevations should be located such that the slope from bearing level to bearing level is flatter than 1:1 horizontal:vertical (H:V).

5.2.3 Resistance to Lateral Loading

Resistance to lateral loads on the shallow foundations can be provided by passive resistance along the edge of the foundation and by frictional resistance along the bottom of the foundation. An allowable equivalent fluid weight of 250 or 300 pounds per cubic foot (pcf) may be used for passive resistance for footings or grade beams poured neat against engineered fill or completely weathered rock, respectively. The upper 12 inches of material in areas not protected by hardscapes should not be included in the calculation of passive resistance. If friction is to be used to resist lateral loads, an allowable coefficient of friction of 0.4 may be used between foundation concrete and engineered fill or undisturbed weathered rock. If frictional and passive resistances are combined, the allowable friction coefficient should be reduced to 0.3. Passive resistance may be increased by one-third for loads that include wind or seismic forces.

5.2.4 Settlement

We anticipate that shallow foundations designed with the bearing pressures presented above may settle approximately ½-inch when loaded.

5.2.5 Modulus of Vertical Subgrade Reaction

Mat or pad foundations may be designed using a coefficient of vertical subgrade reaction (k_1). We recommend a k_1 of 260 tons per cubic foot (tcf) (300 pounds per cubic inch (pci)) for mat/pad foundations bearing on engineered fill or completely weathered rock.

$$k_{(B \times B)} = k_1 \left[\frac{1}{B} \right]$$

The k_1 value is representative of the subgrade modulus as measured from a field load test using square plate of dimensions 1 ft by 1 ft. The value of the

coefficient of subgrade reaction depends on the foundation dimensions. For any given foundation geometry and size, the above recommended modulus should be adjusted as follows:

Square Foundation:

Rectangular Foundation: $k_{(B \times L)} = \frac{k_{(B \times B)} (1+0.5B/L)}{1.5}$

Where,

$k_{(B \times B)}$ = coefficient of vertical subgrade reaction of a square footing having dimensions B ft x B ft (pci)

$k_{(B \times L)}$ = modulus of vertical subgrade reaction of a rectangular footing having dimensions of
B ft x L ft (pci)

k_1 = coefficient of vertical subgrade reaction of a footing measuring 1 ft x 1 ft (pci)

B = foundation width (ft), where B is either the lesser of the width of the column spacing or the width of mat foundation

L = foundation length (ft)

The above recommendations were developed from Terzaghi (1955) as referenced in Das (1999) and are appropriate for granular subgrade soil.

5.3 CONCRETE SLABS-ON-GRADE

A modulus of vertical subgrade reaction of 150 pci may be used to design the concrete slabs-on-grade constructed on engineered fill or completely weathered granitic rock. The Structural Engineer should design the thickness and reinforcement of concrete slabs-on-grade to accommodate concentrated loads and heavy distributed loads. Expansion joints and crack control sawcuts should be included at regular intervals.

Groundwater is expected to be below the planned improvements and special waterproofing measures are not anticipated for interior floor slab of the control shelter. However, waterproofing should be considered if minor moisture seepage through the floor slab due to external water sources, such as landscaping or ponding water, is a concern.

5.4 PAVEMENT

5.4.1 Flexible Pavements

The structural design of Asphalt Concrete (AC) flexible pavement depends primarily on anticipated traffic conditions, subgrade soils, and construction materials. Laboratory subgrade strength testing on a near-surface soil sample collected within Parcel 1 resulted in an R-Value of 57; we have assumed R-value of 45 to be representative of the as-graded condition of the pavement subgrade.

Table 2 provides recommended flexible pavement structural sections for a range of Traffic Indices (TI), which should be confirmed by the project civil engineer. The design assumes a pavement life of 20 years with normal maintenance. The sections assume properly prepared subgrade consisting of at least 12 inches of soil compacted to a minimum of 95 percent relative compaction, as determined by the latest version of ASTM D1557. The aggregate base should be placed at a minimum relative compaction of 95 percent. Aggregate base should conform to Section 26 of the Caltrans Standard Specifications or Section 200-2 of the "Standard Specification for Public Works Construction".

Table 2
Flexible Pavement Structural Sections
Fallbrook Energy Storage Project; Parcel 2

Traffic Index	Asphalt Thickness (in)	Base Thickness (in)
5.0	3.0	4.0
6.0	3.5	5.0
7.0	4.0	6.0

5.4.2 Rigid Pavements

Portland cement concrete (PCC) pavements should be used in areas where dumpsters will be stored and picked up or in areas of anticipated heavy-truck traffic. Our experience indicates that heavy-truck traffic can shorten the useful life of AC sections. We preliminarily recommend the pavement section should consist of 6 inches of PCC over 4 inches of aggregate base or 7 inches PCC over prepared subgrade. The base and soil subgrade should be compacted as recommended above for flexible pavement. The concrete pavements should be provided with expansion joints at regular intervals.

5.5 STORMWATER CONSIDERATIONS

Measures should be taken to properly finish grade the site to direct surface water away from foundations. To avoid the potential for damage to the proposed improvements, we recommend that infiltration into the subsurface soil adjacent to the proposed improvements be avoided.

The project site is gently sloping to the northwest and southeast portions of the site. Subsurface infiltration properties were evaluated at the site by performing percolation testing in four borings, P-1 through P-4. Percolation rates were calculated in minutes per inch (mpi) per County guidelines. These data were then converted to an approximate infiltration rate in inches per hour using the Porchet Method. Percolation test measurements and calculated infiltration rates for Parcel 2 are presented in Table 3a below. The percolation test measurements and calculated infiltration rates performed in Borings P-1 and P-2 from Parcel 1 are presented in Table 3b below.

Table 3a
Infiltration Rates and Percolation Test Measurements; Parcel 2
Fallbrook Battery Storage Project

Test Location	Percolation Rate [1] (min/inch)	Percolation Rate (inches/hr)	Percolation Rate (cm/sec)	Infiltration Rate[2] (inches/hr)
Northwest Corner of the Site				
P-1	21.9	12.44	8.78E-03	0.57
P-2	25.6	10.62	7.49E-03	0.42
Average	23.8	11.5	8.1E-03	0.495
Southeast Corner of the Site				
P-3	1527	0.18	1.26E-04	0.004
P-4	142	1.92	1.35E-03	0.08
Average	835	1.05	7.39E-04	0.042

Note:

1. Percolation rates as determined by borehole percolation tests.
2. Infiltration rate based on conversion from percolation rate using Porchet Method.

Table 3b
Infiltration Rates and Percolation Test Measurements; Parcel 1
Fallbrook Battery Storage Project

Test Location	Percolation Rate [1] (min/inch)	Percolation Rate (inches/hr)	Percolation Rate (cm/sec)	Infiltration Rate[2] (inches/hr)
P-1	288	0.21	1.48E-04	0.0097
P-2	304	0.20	1.40E-04	0.0073
Average	296	0.205	1.44E-04	0.0085

Note:

1. Percolation rates as determined by borehole percolation tests.
2. Infiltration rate based on conversion from percolation rate using Porchet Method.

The measured infiltration rates are indicative of sand or a sand/clay mixture, which is consistent with the material observed in the borings (residual soil, typically clayey sand). We recommend design infiltration rates of 0.25 (0.495/FS=2) and 0.02 (0.04/FS=2) inches per hour at the northwest and southeast corners of the Parcel 2 site, respectively, and to be used in Worksheet C.4-1: Factor of Safety and Design Infiltration Rate Worksheet (County of San Diego 2016 Storm Water Standards) for calculating a design infiltration rate, which indicates "Partial Infiltration" condition (with design infiltration rates between 0.01 and 0.5 inches per hour). Due to the variable weathered nature of the rock at the site, we recommend that the civil designer be aware that the subsurface voids may have a limited volume for water infiltration.

5.6 SEISMIC DESIGN

The Project area will likely be subject to moderate to severe ground shaking in response to a local or more distant large-magnitude earthquake occurring during the expected life of the proposed facilities.

For design in accordance with the 2016 CBC (based on ASCE 7-10), the following parameters should be used. These parameters are developed in the code based on Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motion response accelerations. For the purposes of seismic design, we have classified the site as Site Class C.

Table 4
2016 California Building Code (CBC) Seismic Coefficients
Fallbrook Battery Storage Project

2016 CBC Seismic Coefficients Parameter	Value	Reference
Site Class	C	ASCE 7-10, Table 20.3-1
Mapped Spectral Acceleration - Short Period, S_s (g)	1.233	2016 CBC Figure 1613.3.1(2)[1]
Mapped Spectral Acceleration - 1 Sec. Period, S_1 (g)	0.477	2016 CBC Figure 1613.5(4)[1]
Site Coefficient - Short Period, F_a	1.000	2016 CBC Table 1613.3.3(1)[1]
Site Coefficient - 1 Sec. Period, F_v	1.323	2016 CBC Table 1613.3.3(2)[1]
MCE[2] Spectral Response Acceleration - Short Period, S_{MS} (g)	1.233	2016 CBC Equation 16-37, $S_{MS}=F_aS_S$
MCE[2] Spectral Response Acceleration - 1 Sec. Period, S_{M1} (g)	0.631	2016 CBC Equation 16-38, $S_{M1}=F_vS_1$
Design Spectral Response Acceleration - Short Period, S_{DS} (g)	0.822	2016 CBC Equation 16-39, $S_{DS}=2/3*S_{MS}$
Design Spectral Response Acceleration - 1 Sec. Period, S_{D1} (g)	0.421	2016 CBC Equation 16-40, $S_{D1}=2/3*S_{M1}$

Notes:
1. Calculated using U.S. Seismic Design Maps web application developed by USGS.
2. MCE – Maximum Considered Earthquake.
3. Site coordinates estimated from 'Google Earth' computer program used to evaluate coefficients: 33.38425; -117.23536.

5.7 CORROSIVITY

A near-surface sample within Parcel 2 was tested for chemical properties associated with corrosivity. Results are presented in Appendix B. Laboratory testing resulted in a minimum electrical resistivity of 1,560 ohms-centimeter (ohm-cm); these soils may be considered "Fairly corrosive" to metallic utility piping and conduits. The results of the near-surface tests indicate that the soil has negligible potential for chloride and sulfate attack to concrete.

A corrosion engineer should be consulted for additional design recommendations. The type of concrete and corrosion protection for steel should be determined by the structural and/or corrosion engineer.

5.8 CONSTRUCTION CONSIDERATIONS

5.8.1 Excavation Characteristics

Excavations will be primarily in relatively shallow surficial soils and weathered granitic rock. Shallow foundation and trench excavation in surficial soils is expected to encounter little difficulty and weathered rock is expected to encounter moderate difficulty using modern trenching machines, drill rigs or backhoes for shallow excavations. Conventional earth moving equipment (bulldozers, backhoes, excavators, etc.) should also be able to excavate these deposits to shallow depths with moderate difficulty. Localized corestones and moderately weathered granitic rock should be anticipated within the project area. Moderate to heavy ripping effort and rock excavation techniques may be required for deeper excavations.

This assessment assumes that the excavating equipment is well maintained and operating at factory-specified efficiencies. The choice of excavation method is often a function of economics, level of desired effort, logistics, quality and size of machinery used, permit conditions, and contractor convenience.

5.8.2 Temporary Slopes

The design and construction of temporary slopes, as well as their maintenance and monitoring during construction, is the responsibility of the Contractor. The Contractor should have a geotechnical or geological professional evaluate the soil/rock conditions encountered during excavation to determine permissible temporary slope inclinations and other measures as required by California OSHA (Cal/OSHA). The Contractor's geotechnical or geological professional may use the factual information provided in this report, as well as any additional data they may need to acquire, to assess the stability of temporary slopes and prepare a specific temporary slope analysis and/or develop parameters to design temporary support systems.

Based on the existing data interpreted from site reconnaissance and subsurface exploration, the design of temporary slopes and benches for planning purposes may assume Cal/OSHA Type C for subsurface soils.

Existing infrastructure that is within a 2:1 H:V line projected up from the bottom edge (toe) of temporary slopes should be monitored during construction.

The Contractor should note the materials encountered in construction excavations could vary significantly across the site. The above assessment of Cal/OSHA soil type for temporary excavations is based on preliminary engineering classifications of material encountered in widely spaced excavations. The Contractor's geotechnical or geological professional should observe and map mass excavations and temporary slopes at regular intervals during excavation and assess the stability of temporary slopes, as necessary.

The tops of all excavations should be graded to prevent runoff from entering the excavation. Temporary slopes should not be allowed to become soaked with water or to dry out. Surcharge loads should not be permitted near the edge of excavations; they should be located a horizontal distance greater than the depth of the cut, measured horizontally from the top edge of the excavation, unless the cut is properly shored and designed to accommodate the surcharge.

5.9 CONSTRUCTION OBSERVATION AND TESTING

Earthwork and placement of engineered fill should be performed under the observation and testing services of a geotechnical professional supervised by a California-registered Geotechnical Engineer. Tests should be taken to determine the in-place moisture and relative compaction of engineered fill. Observation and mapping of removals of unsuitable materials and any temporary excavations should be performed by the project geotechnical consultant.

All foundation excavations, and slab and pavement subgrade soils, should be continuously observed by a geotechnical or geologic professional prior to placement of steel and concrete to observe that the subgrade is satisfactory. Foundation excavations should be free of soft, loose and disturbed soils.

A California-registered Geotechnical Engineer should prepare a final report of foundation installation, and earthwork testing and observation.

5.10 ADDITIONAL GEOTECHNICAL SERVICES

AECOM has prepared this report based on available assumptions of Project design. Once the Project design is progressed sufficiently, AECOM should review the plans and confirm the recommendations provided in this report are applicable. We also recommend that AECOM assist engineering changes during construction and review final construction documentation, including drawings, specifications and special provisions. We recommend that AECOM observe earthwork observation and provide testing as applicable, including foundation bearing surfaces.

SECTION 6 LIMITATIONS

AECOM has observed only a very small portion of the pertinent subsurface conditions. The recommendations presented in this report are based on the assumption that soil and geologic conditions do not deviate appreciably from those observed in the previous and current subsurface explorations.

We recommend that AECOM provide observation and testing during subgrade preparation and fill placement, utility trench backfill, foundation excavations, and other forms of geotechnically significant types of construction to evaluate if the site conditions are as anticipated, or to provide revised recommendations, if necessary. If variations or undesirable geotechnical conditions are encountered during construction, AECOM should be consulted for further recommendations.

This report is not a contractual statement of geotechnical conditions (baseline report). The contractor should make their own interpretations using the factual information provided in this report.

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgments presented herein are based partly on our understanding of the proposed construction, and partly on our general experience. Our engineering work and judgments rendered meet current professional standards; we do not guarantee the performance of the project in any respect.

SECTION 7 REFERENCES

AECOM, 2017. Geotechnical Investigation, San Diego Gas & Electric, Fallbrook Battery Storage Project; Parcel 1, Fallbrook, California, dated February 27, 2017 (Project No. 60534181).

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VICINITY MAP
SDG&E FALLBROOK BATTERY STORAGE PROJECT; PARCEL 2
FALLBROOK, CA

AECOM

CHECKED BY: PB	DATE: 5-25-17	FIG. NO:
PM: PB	PROJ. NO: 60544320	1

U:\Projects\AES Energy Storage\60544320_SDG&E Fallbrook_Percolation\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 1 - Vicinity Map.dwg May 23, 2017 - 5:25pm

LEGEND

- B-1 APPROXIMATE BORING LOCATION (Parcel 2 – This Project)
- P-2 APPROXIMATE PERCOLATION TEST LOCATION (Parcel 2 – This Project)
- Res 1 APPROXIMATE LOCATION OF RESISTIVITY ARRAY
- B-1 APPROXIMATE BORING LOCATION (Parcel 1)
- P-2 APPROXIMATE PERCOLATION TEST LOCATION (Parcel 1)

AECOM

SCALE: 1" = 200' (100 0 100 200)

SITE PLAN
SDG&E FALLBROOK BATTERY STORAGE PROJECT; PARCEL 2
FALLBROOK, CA

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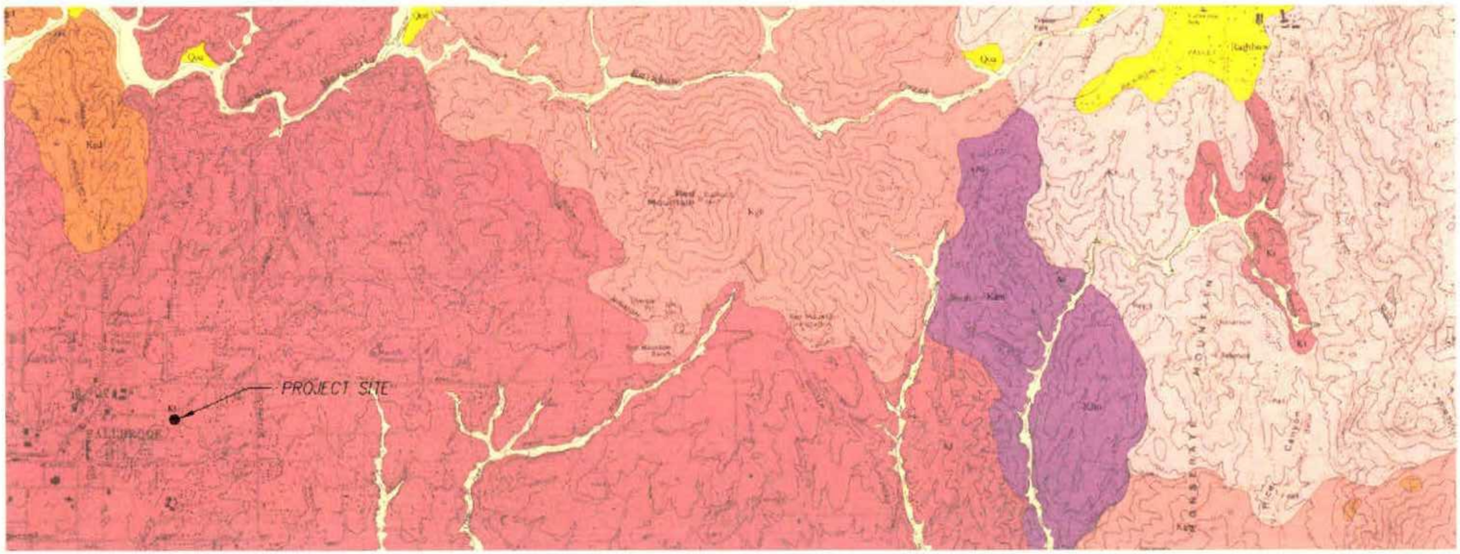
PM: PB	PROJ. NO: 60544320	2

U:\Projects\AES Energy Storage\60544320_SDG&E Fallbrook_Percolation\900-CAD-GIS\910-CAD\20-SHEETS\FIGURE 2 - Site Plan.dwg May 24, 2017 - 4:58pm



LEGEND

EXPLANATION OF MAP UNITS

MODERN SURFICIAL DEPOSITS - Sediment that has been recently transported and deposited in channels and washes, on surfaces of alluvial fans and alluvial plains, and on hillslopes and in artificial fills. Soil-profile development is non-existent. Includes:

Qa	Active alluvial flood plain deposits (late Holocene) - Unconsolidated to locally poorly consolidated sand and gravel deposits in active alluvial flood plains.
Qls	Landslide deposits (Holocene to Pleistocene) - Landslide slump and rock fall deposits

OLD SURFICIAL DEPOSITS - Sedimentary units that are moderately consolidated and slightly to moderately well dissected. Older surficial deposits have upper surfaces that are capped by moderately to well-developed pedogenic soils. Includes:

Qoa	Older alluvial flood plain deposits (Pleistocene, younger than 500,000 years) - Mostly moderately well consolidated, poorly sorted, permeable flood plain deposits.
Qp	Pauba Formation sandstone facies (Pleistocene) - Light brown moderately well-indurated, extensively crossbedded, channeled and filled sandstone and siltstone that contains occasional intervening cobble-and-boulder conglomerate beds.
Qpf	Pauba Formation fanglomerate facies (Pleistocene) - well-indurated, poorly sorted sedimentary breccia and mudstone

BEDROCK UNITS

Kr	Granodiorite of Rainbow (Cretaceous) - Leucocratic hornblende-biotite granodiorite; medium to coarse grained, massive
Kgd	Granodiorite undivided (Cretaceous) - Mostly hornblende-biotite granodiorite; coarse to medium grained
Kt	Tonalite undivided (Cretaceous) - Mostly hornblende-biotite tonalite; coarse grained, light gray
Kgb	Gabbro undivided (Cretaceous) - Mostly biotite-hornblende-hypersthene gabbro; coarse grained, dark gray, massive
KJm	Metavolcanic and metasedimentary rocks undivided (Cretaceous and Jurassic) - Low grade (greenschist facies) rocks that are in part coeval with and in part older than the Cretaceous plutonic rocks they lie in contact with

REGIONAL GEOLOGIC MAP
SDG&E FALLBROOK BATTERY STORAGE PROJECT; PARCEL2
FALLBROOK, CA

AECOM

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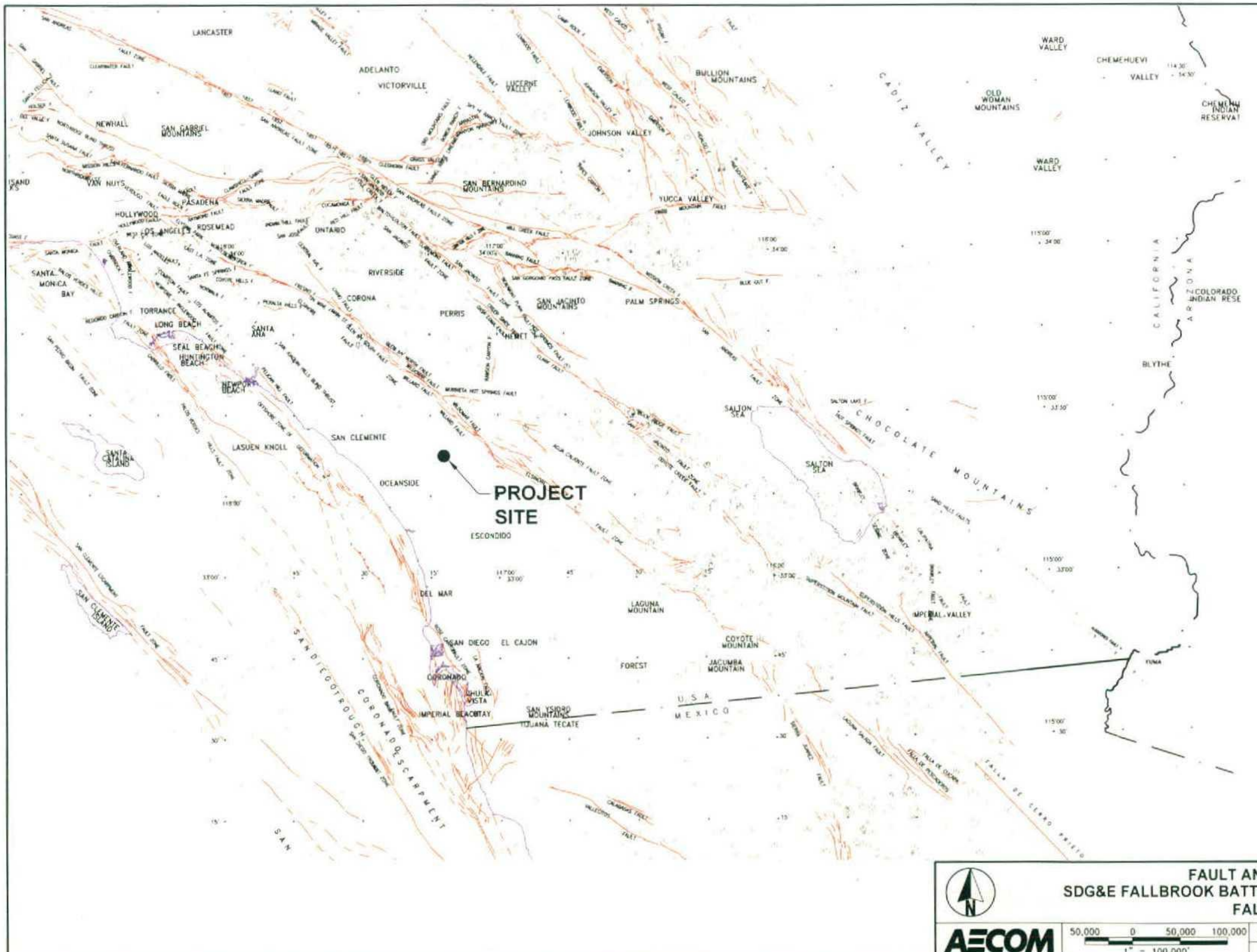
PM: PB	PROJ. NO: 60544320	3



LEGEND:

REPORTED EARTHQUAKE MAGNITUDES.

- 4.0 TO 4.9
- 5.0 TO 5.9
- 6.0 TO 6.9
- 7.0 AND GREATER

SOUTH OF LATITUDE 35°N, EPICENTER AND MAGNITUDE DATA ARE FROM THE CALIFORNIA GEOLOGICAL SURVEY (2000) EARTHQUAKE CATALOG FOR THE PERIOD FROM 1769 TO 2000. ONLY EARTHQUAKES OF MAGNITUDE 4.0 AND LARGER ARE SHOWN. AFTERSHOCKS ARE NOT INCLUDED.

? ? ?

APPROXIMATE LOCATION OF HOLOCENE AND PLEISTOCENE FAULTS, DOTTED WHERE CONCEALED, QUERIED WHERE CONJECTURAL. FAULT LOCATIONS BASED ON: ZIONY AND JONES, 1989; CDMG GEOLOGIC MAP SERIES OF CALIFORNIA, 1977–1986 (1:250,000 SCALE); CDMG GEOLOGIC MAP SERIES, CALIFORNIA CONTINENTAL MARGIN, 1987 (1:250,000 SCALE); HAUKSSON, 1990; SHAW AND SHEARER, 1999; WRIGHT, 1991; GRANT ET AL. 1999.

FAULT AND EPICENTER MAP
SDG&E FALLBROOK BATTERY STORAGE PROJECT; PARCEL 2
FALLBROOK, CA

AECOM

50,000 0 50,000 100,000 1" = 100,000'	CHECKED BY: PB	DATE: 5-25-17	FIG. NO: 4
	PM: PB	PROJ. NO: 60544320	

Parcel 1 field investigation consisted of a geotechnical program that included six exploratory borings and two in-situ percolation tests. The borings were performed for this investigation by AECOM at Parcel 1 to depths ranging from 6 to 19 feet bgs. The locations of Parcel 1 explorations are shown on the Site Plan (Figure 2).

AECOM prepared an internal safe work plan for the project. Prior to field activities, AECOM notified Underground Service Alert (USA) to locate underground utilities.

The borings were advanced by Pacific Drilling with a truck mounted Marl M5 drill rig using hollow-stem augers, and were designated B-1 through B-4 and P-1 and P-2. Grab, bulk and drive samples were collected from the borings. The drive samples were obtained using a Standard Penetration Test (SPT) sampler and a split-spoon sampler (2.5-inch inside diameter). Blow counts required to drive the samplers the final 12 inches were recorded to evaluate the relative density or consistency of the subsurface material. The reported field blow counts have not been corrected for sampler size or depth. The drive samples and cuttings were reviewed and classified according to the Unified Soil Classification System. The borings were backfilled with a bentonite seal and soil cuttings.

Locations of the field explorations are presented in Figure 2. A Key to Logs is presented as Figure A-1. Logs of the borings are presented as Figures A-2 through A-7.

Percolation tests were performed in Borings P-1 and P-2 to evaluate the infiltration rate. The test holes were presoaked at the completion of drilling (February 1, 2017) by filling each hole with about 12 to 18 inches of water. This water level was maintained for about 4 hours. The water was then allowed to infiltrate overnight to generate a "wetted zone" prior to testing. The following day (February 2, 2017), it was observed that the presoak water had dissipated into the subsurface. Water was then added to each of the holes to a depth approximately 12 to 14 inches above the bottom of the hole. The depth to water from a fixed point at the surface was noted. Depth measurements were then collected on a regular interval. The last measurement is used to calculate the infiltration rate. An electronic sounder was used to make the depth measurements to the accuracy of 1/100th of a foot in order to measure the amount of drop (or percolation).

Geotechnical laboratory testing was performed in general accordance with ASTM standards. Results of laboratory testing performed are presented in this appendix. The results of moisture content and fines content are shown at the corresponding sample locations on the boring logs in Appendix A.

Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Key to Logs** Sheet 1 of 1

Elevation, feet	Depth, feet	SAMPLES			Graphic Log	MATERIAL DESCRIPTION	Dry Density, pcf	Dry Density, pcf	REMARKS AND OTHER TESTS
		Type	Number						
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to NAVD88 or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number. Unnumbered sample indicates no sample recovery. "1-1" indicates geotechnical sample. "(B-1@1')" indicates analytical sample.

5 **Blows per foot:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop.

6 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

7 **Material Description:** Description of material encountered; may include relative density/consistency, moisture, color, particle size; texture, weathering, and strength of formation material. If shown, designation in parentheses denotes Munsell color classification.

8 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

9 **Dry Unit Weight:** Dry unit weight of soil sample measured in laboratory, in pounds per cubic foot.

10 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

SA	Sieve analysis, %<#200 sieve
WA	Three-point wash sieve, %<#200 sieve
LL	Liquid limit (from Atterberg limits test), %
PI	Plasticity Index [LL - PL], %; NP=nonplastic
CORR	Corrosivity Test suite
COMP	Compaction Curve (ASTM 1557D)
R-Value	R-Value test
THER	Thermal Resistivity Test (IEEE 442)

TYPICAL MATERIAL GRAPHIC SYMBOLS

- Silty SAND (SM)
- Clayey SAND (SC)
- Poorly-graded SAND (SP)
- Poorly-graded SAND with clay (SP-SC)
- Well-graded SAND with silt (SW-SM)
- Poorly-graded SAND (SP-SM) with silt

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Sampler
- 2.5" ID Drive Sample
- Bulk Sample

OTHER GRAPHIC SYMBOLS

- First water encountered at time of drilling and sampling (ATD)
- Static water level measured in boring or well at specified time after drilling
- Change in material properties within a lithologic stratum
- Inferred contact between strata or gradational change in lithology

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring B-1

Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.7 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	803 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38518, W: -117.23492		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Approximately 1-foot of Fill over dense, moist, dark brown silty SAND (SM), with trace clay	5		
800			1	42		**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow silty SAND (SM), with some gravel			THER
	5		2	84 11"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow well-graded SAND with silt (SW-SM), with little gravel			
795			3	50 4"					
	10		4	50 5"			4		SA(9)
790									
	15		5	50 5"		Very dense, moist, brownish yellow, poorly-graded SAND (SP)	5	118	
785			6	50 5"			4		
						Bottom of boring at 18.7'			
	20								
780									
	25								

AECOM

Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring B-2** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	800 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38518, W: -117.23460		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
800	0					**Residual Soil** Shallow Fill (~1') over dense, moist, dark brown silty SAND (SM), with trace clay			
			1	17		**Completely Weathered Granitic Rock** excavates to: medium dense, moist, dark brown clayey SAND (SC), with trace fine gravel	12		WA(47)
795	5		2	83 11"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow silty SAND (SM), with some fine gravel			THER
			3	76 9"		Very dense, moist, brownish yellow, poorly-graded SAND (SP-SM) with silt	13		
790	10		4	50 3"					No Recovery
						Becomes light yellowish brown			
785	15		5	50 3"					No Recovery
			6	50 2"					No Recovery
						Bottom of boring at 18.5 feet			
780	20								
775	25								

AECOM

Figure A-3

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring B-3

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	19.2 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38551, W: -117.23463		

Elevation, feet	Depth, feet	SAMPLES Number	Blows per foot	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0			**Residual Soil** Shallow Fill (~1') over dense, moist, dark brown clayey SAND (SC)			
		1a					R-Value, COMP
		1	53		12	128	LL(40), PI(26), WA(28)
790				**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow clayey SAND (SC), with some fine gravel			
	5	2	88 10"	**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow Poorly-graded SAND (SP), with some fine gravel	8		
		3	50 4"	Becomes very pale brown	4	113	
785							
	10	4	84 10"		4		
780							
	15	5	93 9"		4	124	
775		6	87 10"	Becomes dark grayish brown	4		
				Bottom of boring at 19.2 feet			
	20						
770							
	25						

AECOM

Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring B-4** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	18.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	791 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT, 2.5" ID	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings with bentonite seal	Location	N: 33.38554 W: -117.23499		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC), with trace fine gravel			
790									
			1	26		**Completely Weathered Granitic Rock** excavates to: medium dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
	5		2	93 9"		**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow clayey SAND (SC)			THER
785									
			3	83 11"			14		SA(43)
	10		4	50 3"					No Recovery
780									
	15		5	50 3"		Very dense, moist, dark grayish brown Poorly-graded SAND (SP)	2		
775									
			6	50 2"			2		
						Bottom of boring at 18.5 feet			
	20								
770									
	25								

AECOM

Project: SDG&E Fallbrook Battery Storage Project Project Location: Fallbrook, CA Project Number: 60534181.10000	**Log of Boring P-1** Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	6.0 feet
Drill Rig Type	Marl M5, Truck mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings	Location	N: 33.38580, W: -117.23489		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC)			
		SPT	1	20					
790						**Completely Weathered Granitic Rock** excavates to: dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
	5	SPT	2	42					
						Bottom of boring at 6 feet			
785									
	10								
780									
	15								
775									
	20								
770									
	25								

Project: SDG&E Fallbrook Battery Storage Project
Project Location: Fallbrook, CA
Project Number: 60534181.10000

Log of Boring P-2

Sheet 1 of 1

Date(s) Drilled	2/1/17	Logged By	Ryan Bourdette	Checked By	Derek Rector
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7-inch finger bit	Total Depth of Borehole	6.0 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	794 feet
Water Level Depth	not encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	soil cuttings	Location	N: 33.38581, W: -117.23505		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Residual Soil to Completely Weathered Granitic Rock** Shallow Fill (~1') over medium dense, moist, dark brown clayey SAND (SC)			
		SPT	1	17					
790						**Highly Weathered Granitic Rock** excavates to: very dense, moist, brownish yellow silty SAND (SM), with some fine gravel			
	5	SPT	2	65					
						Bottom of boring at 6 feet			
785	10								
780	15								
775	20								
770	25								

SDG&E Fallbrook Energy Storage Project, California
Percolation Test Data

P-1 (Basin)			Description		Boring Diameter	7	inches
					Boring Depth	6.00	feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
2/1/2017	Pre-soak	14:46	0	NA	NA	NA	NA
	add water						
2/2/2017	add water	9:32 AM	0	NA	NA	NA	NA
		10:09 AM	37	0.02	154.2	0.39	2.75E-04
		10:39 AM	30	0.02	125.0	0.48	3.39E-04
		11:16 AM	37	0.01	308.3	0.2	1.37E-04
	add water	11:38 AM	22	NA	NA	NA	NA
		12:10 PM	32	0.01	266.7	0.2	1.59E-04
		Average (last two) readings =			287.5	0.21	1.48E-04

P-2 (Basin)			Description		Boring Diameter	7	inches
					Boring Depth	6.00	feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
2/1/2017	Pre-soak	14:54	0	NA	NA	NA	NA
	add water						
2/2/2017	add water	9:34 AM	0	NA	NA	NA	NA
		10:07 AM	33	0.01	275.0	0.22	1.54E-04
		10:43 AM	36	0.00	#DIV/0!	#DIV/0!	#DIV/0!
		11:22 AM	39	0.00	#DIV/0!	#DIV/0!	#DIV/0!
	add water	11:34 AM	12	NA	NA	NA	NA
		12:14 PM	40	0.01	333.3	0.18	1.27E-04
		Average (last two) readings =			304.2	0.2	1.40E-04

Infiltration Rate
Per Porchet Method

P-1: H_{avg} = 33.3 inches
I = 0.0097 in/hr Slowest Reading

P-2: H_{avg} = 41.34 inches
I = 0.0073 in/hr Slowest Reading

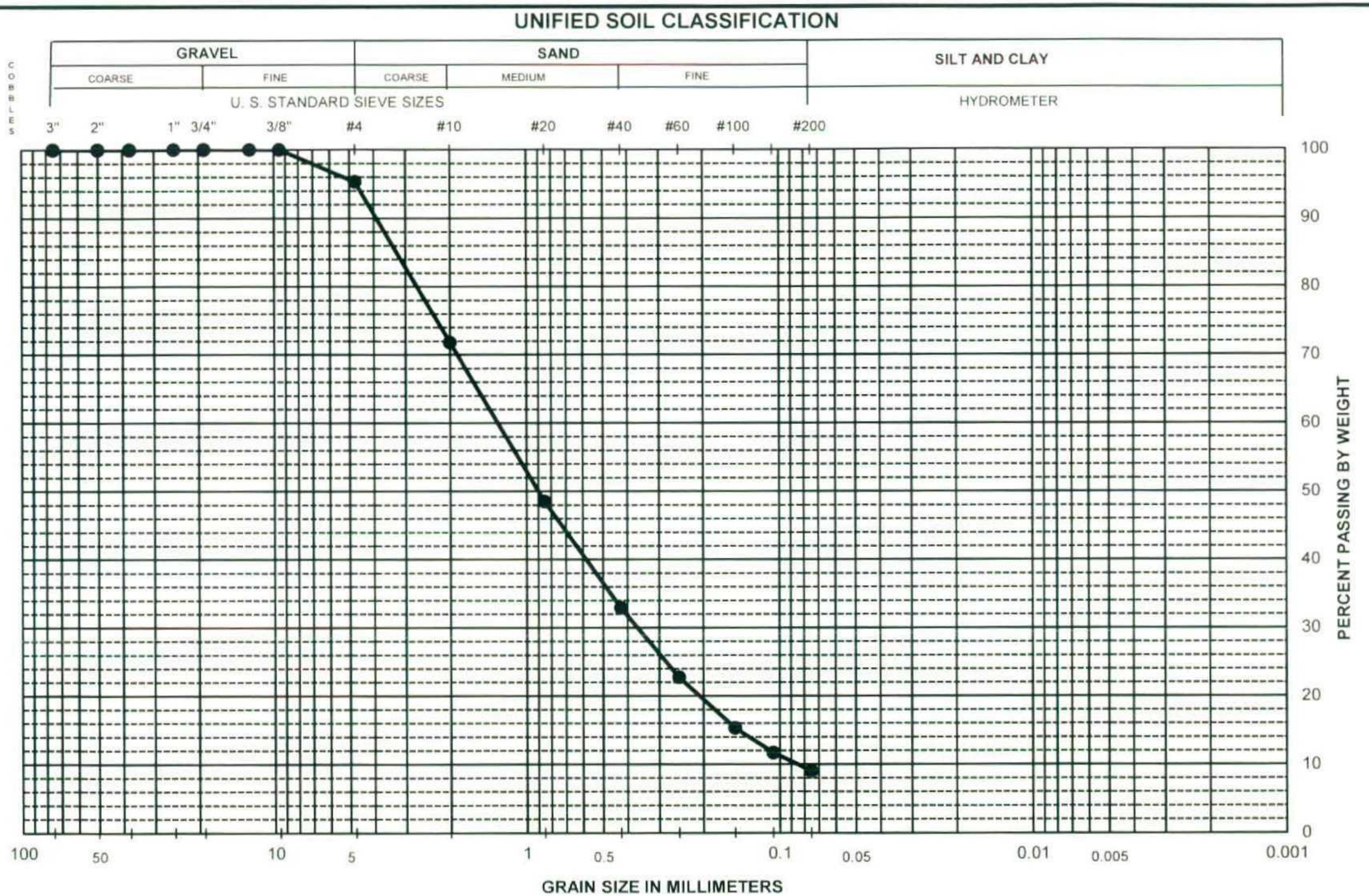
Porchet Method Calculation Example

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$

Havg - Height of last 2 readings
r - radius of boring

ΔH = 0.06 ft = 0.72 in
r = 3.5 inches
Δt = 30 min
H_{avg} = 3.84 in

Figure A-8



Sieve No.	Dia mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	95.3
#10	2.00	71.8
#20	0.850	48.5
#40	0.425	32.9
#60	0.250	22.7
#100	0.150	15.3
#140	0.106	11.7
#200	0.075	9.0
Hydrometer Analysis		

% Cobbles	0.0
% Gravel	4.7
% Sand	86.3
% Fines	9.0
D_{85}	3.251
D_{60}	1.297
D_{50}	0.898
D_{30}	0.365
D_{15}	0.146
D_{10}	0.085
C_u	15.2
C_c	1.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-1	4	10.0	●	3.5	---	---	---	**Brownish yellow Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **SDG&E Fallbrook Substation**

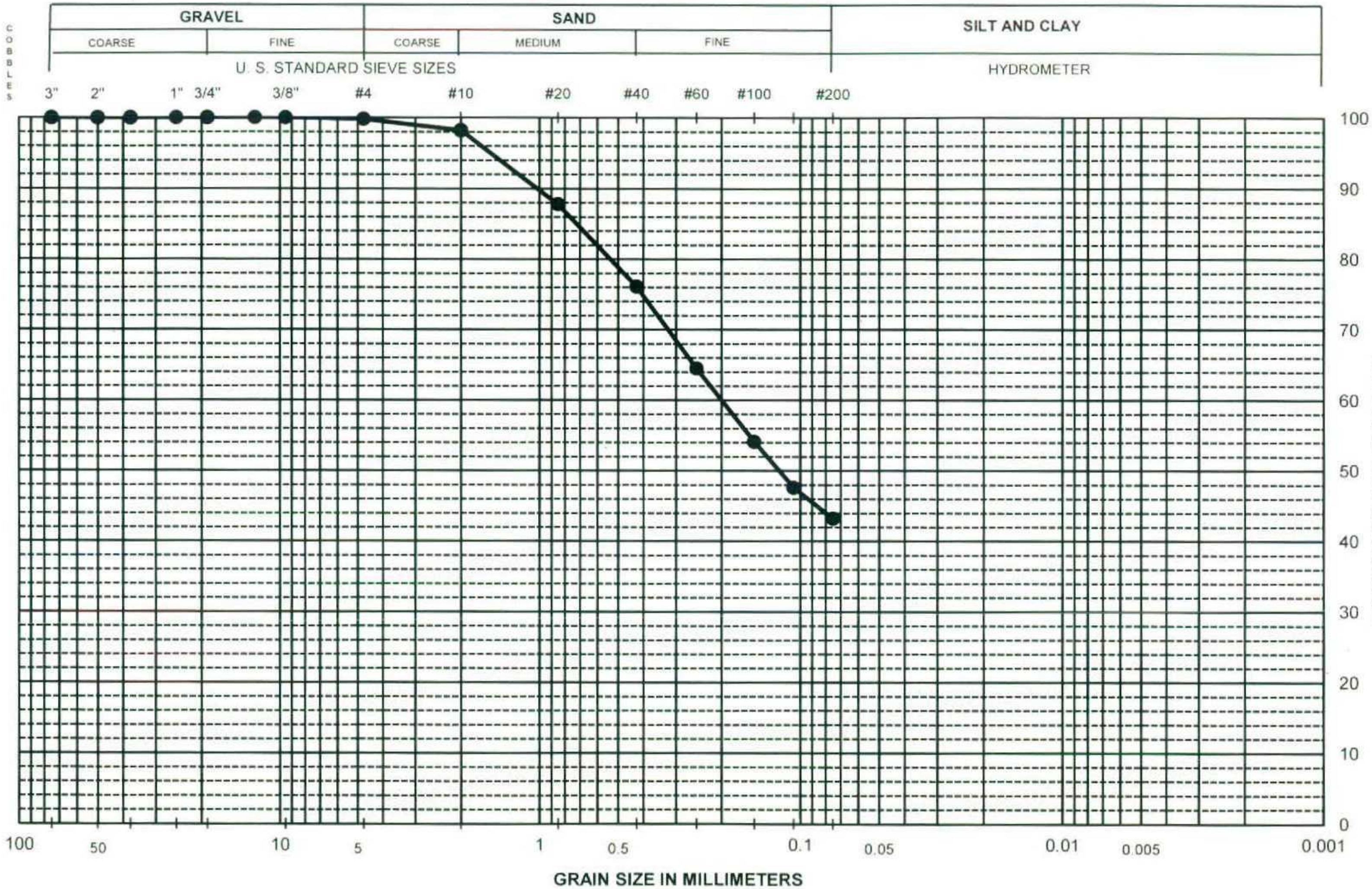
PROJECT NUMBER: **60534181**

PARTICLE-SIZE DISTRIBUTION CURVES

U:\Projects_Jobs\60534181_Casteel\400-Technical\440-Field and Laboratory Data\Lab Testing\Sieve SDG&E Fallbrook SubS B-1 10 ft.xlsx

AECOM

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	99.8
#10	2.00	98.2
#20	0.850	87.8
#40	0.425	76.1
#60	0.250	64.5
#100	0.150	54.1
#140	0.106	47.6
#200	0.075	43.2
Hydrometer Analysis		

% Cobbles	0.0
% Gravel	0.2
% Sand	56.6
% Fines	43.2
D_{85}	0.720
D_{60}	0.200
D_{50}	0.120
D_{30}	#N/A
D_{15}	#N/A
D_{10}	#N/A
C_u	----
C_c	-----

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-4	3	7.5	●	14.3	---	---	---	**Brownish yellow Clayey SAND (SC)**

PROJECT NAME: SDG&E Fallbrook Substation

PROJECT NUMBER: 60534181

PARTICLE-SIZE DISTRIBUTION CURVES

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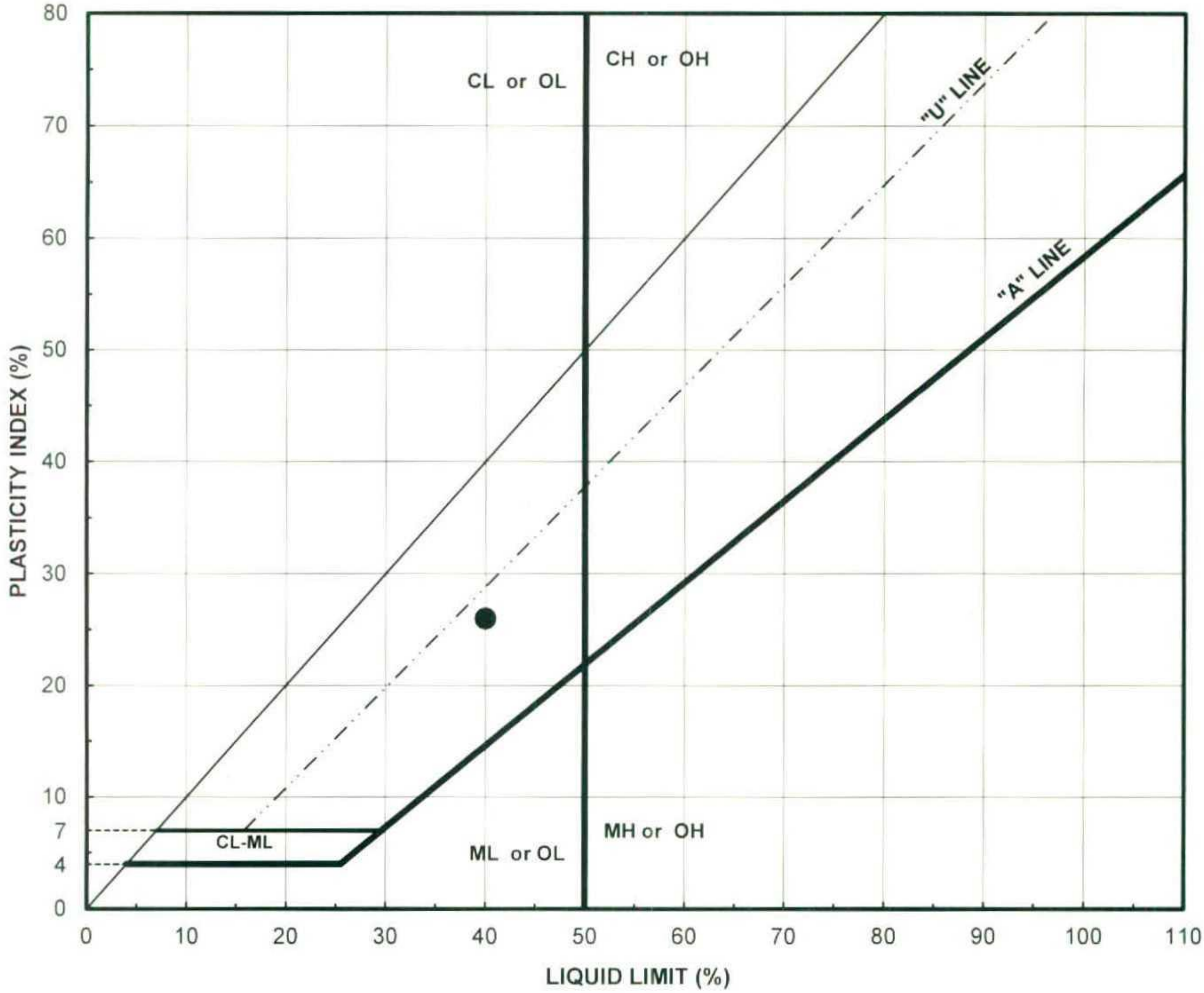
AECOM



Boring Number	Sample Number	Depth (ft)	Water Content (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B-3	1	2.5	12.0	40	26	Brownish yellow Clayey SAND (SC)

Project Name: **SDG&E Fallbrook Substation**

PLASTICITY CHART

Project Number: **60534181**

N|V|5

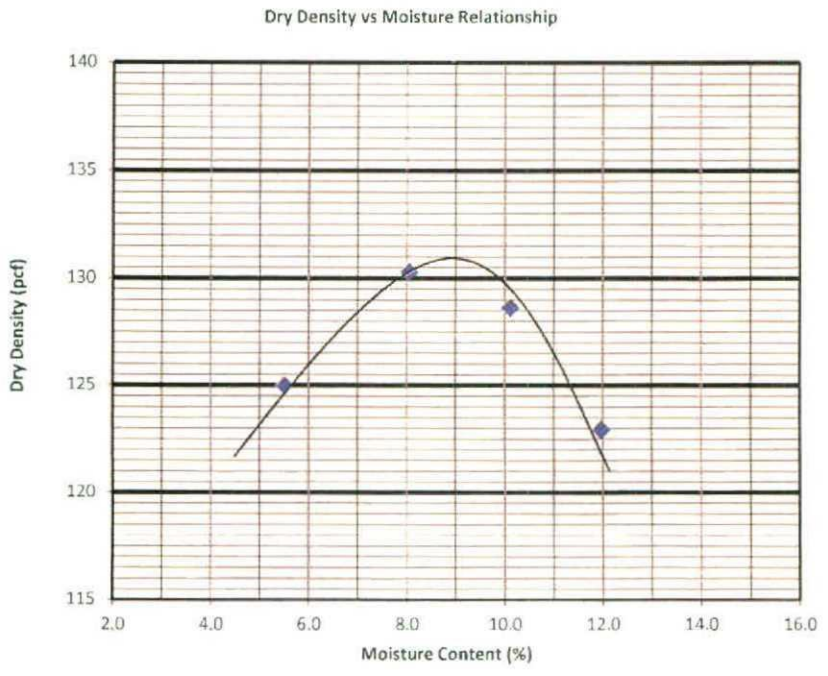
REPORT OF MOISTURE/DENSITY RELATIONSHIP TEST

(ASTM D1557/D698)

Date:	February 16, 2017	Job Number:	891
Client:	URS Corporation (San Diego, CA)	Report Number:	4803
Address:	P.O. Box 203970	Lab Number:	113843
	Austin, Texas		

Project:	Fallbrook Substation			
Project Address:	Fallbrook, California			
Material:	Brown silty SAND (SM)	Mold Size:	4	inch
Material Source:	Native			
Location:	Bulk 1 (1'-2')	ASTM D1557	A	
Date Sampled:	2/10/2017			
Date Submitted:	2/10/2017			
Sampled By:	PB			

Maximum Dry Density = 131.0 pcf **Optimum Moisture = 9.0%**



Distribution

Client

File

Reviewed By:

Sam Koohi, PE

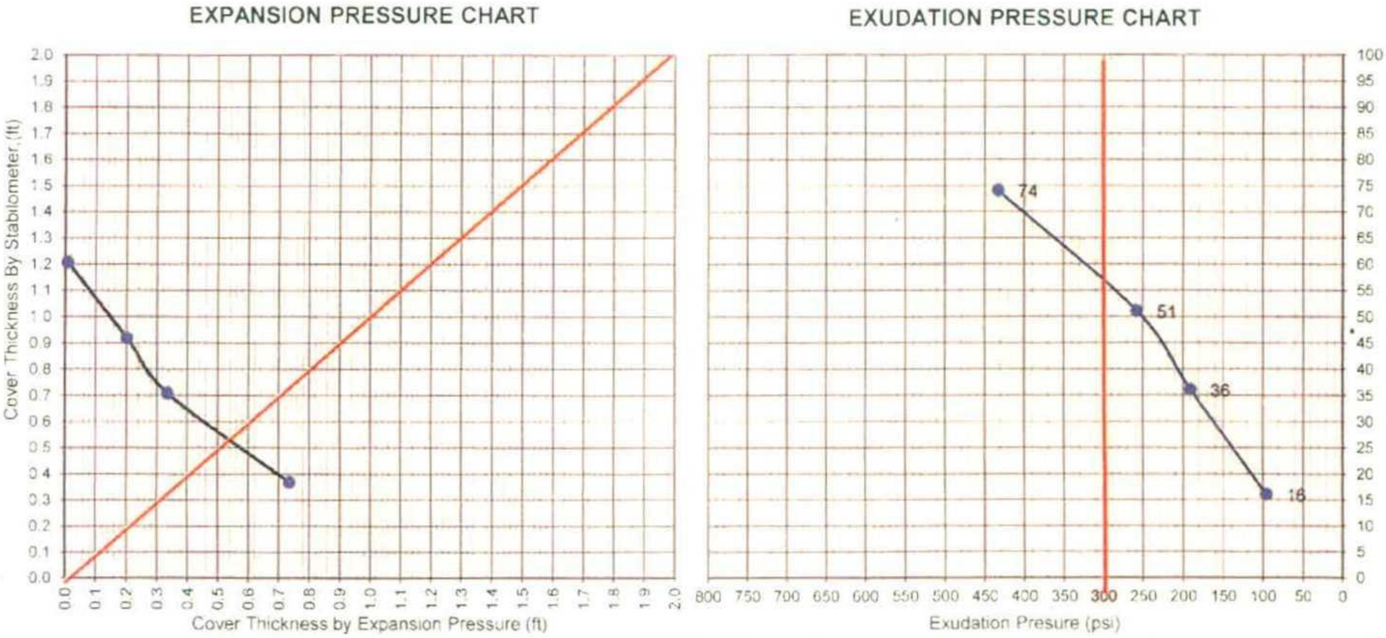
Engineering Manager

RESISTANCE "R" VALUE TEST

(CTM301 Caltrans / ASTM D2844)

Date:	2/16/2017	Job Number:	891
Client:	URS Corporation (San Diego, CA)	Report Number:	4803
Address:	P.O. Box 203970 Austin, Texas	Lab Number:	113843
Project :	Fallbrook Substation		
Project Address :	Fallbrook, California		

Material:	Brown silty SAND (SM)
Material Source:	Native
Location:	Bulk 1 (1'-2')
Sampled By:	PB
Date Sampled:	2/10/2017
Date Received:	2/10/2017



TEST SPECIMEN	A	B	C	D
COMP. FOOT PRESSURE, psi	350	350	275	70
INITIAL MOISTURE %	6.7	6.7	6.7	6.7
MOISTURE @ COMPACTION %	10.3	11.1	12.0	13.8
DRY DENSITY, pcf	124.8	124.8	123.1	120.6
EXUDATION PRESSURE, psi	433	258	191	96
STABILOMETER VALUE 'R'	74	51	36	16

R-VALUE BY EXUDATION	57
R-VALUE BY EXPANSION	64
R-VALUE AT EQUILIBRIUM	**57**

Respectfully Submitted,
NV5 West, Inc.

Sam Koohi, PE
Engineering Manager

Table 1 - Laboratory Tests on Soil Samples

AECOM
SDGE Fall Break
Your #60534181.100, HDR Lab #17-0109LAB
23-Feb-17

Sample ID			B-2, S-3 @ 7.5' SM
Resistivity		**Units**	
as-received		ohm-cm	19,600
minimum		ohm-cm	1,560
pH			7.7
Electrical Conductivity		mS/cm	0.15
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	11
magnesium	Mg^{2+}	mg/kg	6.6
sodium	Na^{1+}	mg/kg	158
potassium	K^{1+}	mg/kg	3.1
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	85
fluoride	F^{1-}	mg/kg	4.9
chloride	Cl^{1-}	mg/kg	46
sulfate	SO_4^{2-}	mg/kg	176
phosphate	PO_4^{3-}	mg/kg	ND
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	16
sulfide	S^{2-}	qual	na
Redox		mV	na

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Attn:	Pallavi Balasubramanyam
Client Name:	URS Corporation

NV5

Project:	Fallbrook Substation (URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

Test Material Description:	Brown silty CLAY (CL)
Test Material ID:	B-1 @ 2.5'
Sample Date:	2/01/17

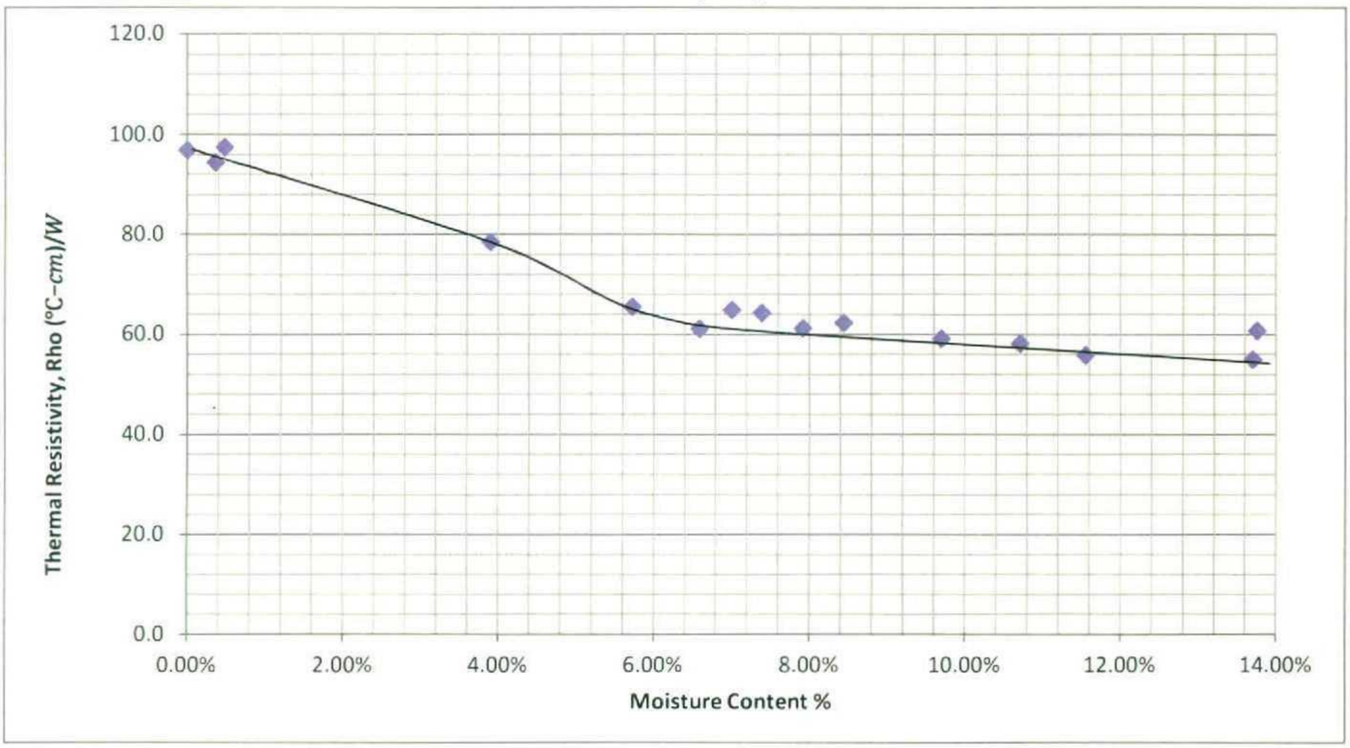
Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	109.7	Field Moisture (%)	13.7
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	96.8	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	78

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

Attn: Pallavi Balasubramanyam
Client Name: URS Corporation

Project: Fallbrook Substation
(URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

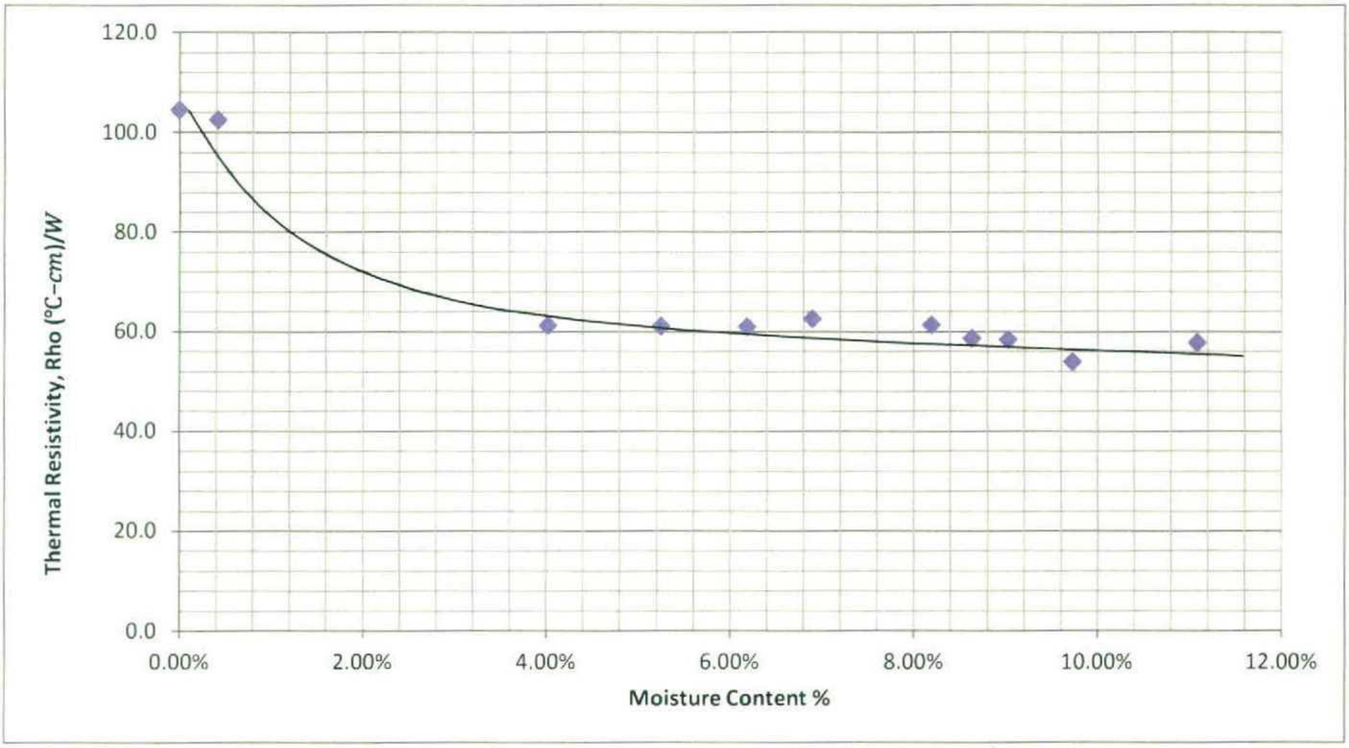
Test Material Description: Tan Brown silty SAND (SM-SP)
Test Material ID: B-2 @ 5'
Sample Date: 2/01/17 Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	116.5	Field Moisture (%)	8.6
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	104.5	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	62

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

Attn:	Pallavi Balasubramanyam
Client Name:	URS Corporation

Project: Fallbrook Substation
(URS Project No. 60534181)

Report Date: 02/24/2017
NV5 Project No.:

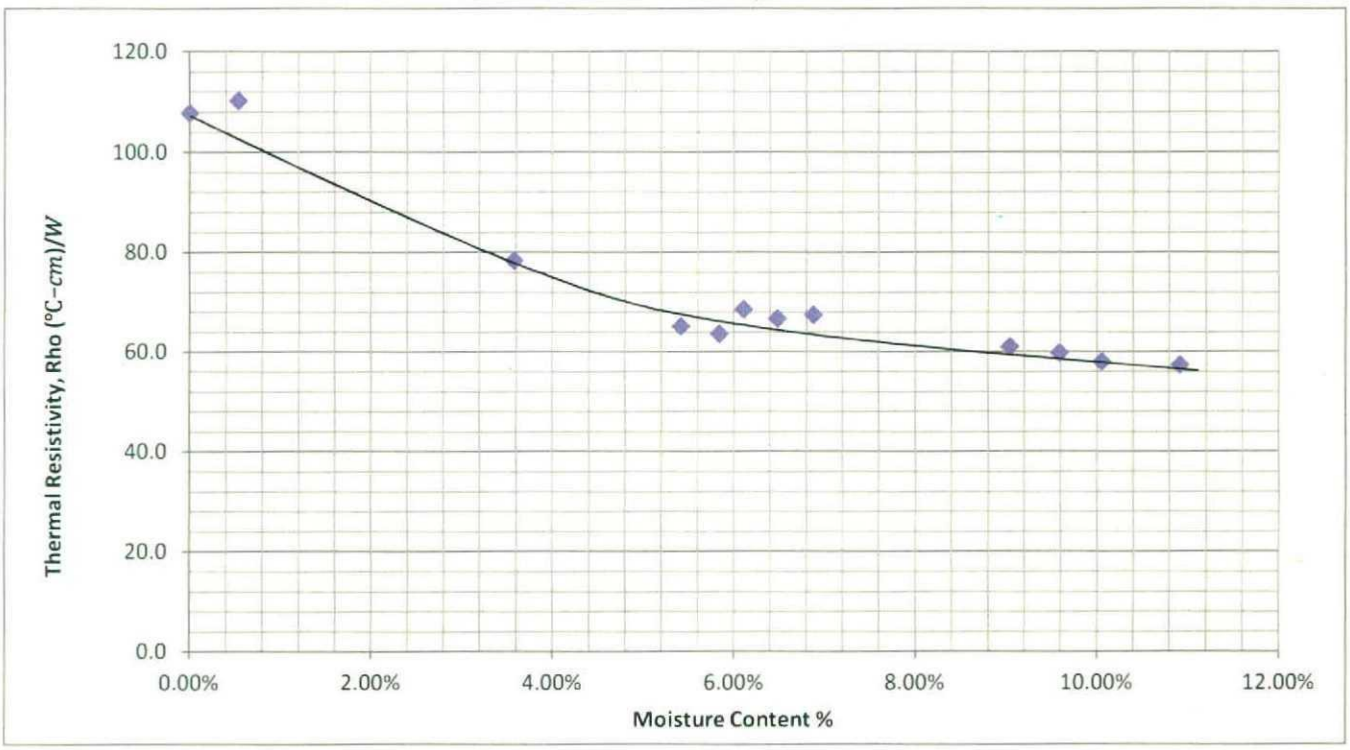
Test Material Description:	Tan Brown silty SAND (SM-SP)	
Test Material ID:	B-4 @ 5'	
Sample Date:	2/01/17	Submitted Date: 2/07/17

Test Description	Test Method	# of Samples
Thermal Resistivity measurement	IEEE 442	1

Probe Type: TR1
Ambient Temperature: 22 °C

Dry Unit Weight (pcf)	114.5	Field Moisture (%)	10
Tested Max. Thermal Resistivity at 0% Moisture (°C-cm/W)	107.8	Tested Max. Thermal Resistivity at 4% Critical Moisture (°C-cm/W)	75

Thermal Resistivity Dryout Curve



Copies:

Respectfully submitted,
NV5

Sam Koohi, P.E.
Engineering Manager

Our field investigation consisted of a geotechnical program that included six exploratory borings and two in-situ percolation tests. The borings performed for this investigation by AECOM at the Project site to depths ranging from 5 to 10 feet bgs. The locations of the explorations are shown on the Site Plan (Figure 2).

AECOM prepared an internal safe work plan for the project. Prior to field activities, AECOM notified Underground Service Alert (USA) to locate underground utilities.

The borings were advanced by Pacific Drilling with a truck mounted Marl M5 drill rig using hollow-stem augers, and were designated B-1 and B-2 and P-1 through P-4. Grab and drive samples were collected only from geotechnical borings B-1 and B-2. The drive samples were obtained using a Standard Penetration Test (SPT) sampler. Blow counts required to drive the samplers the final 12 inches were recorded to evaluate the relative density or consistency of the subsurface material. The reported field blow counts have not been corrected for sampler size or depth. The drive samples and cuttings were reviewed and classified according to the Unified Soil Classification System. The borings were backfilled with soil cuttings.

Locations of the field explorations are presented in Figure 2. A Key to Logs is presented as Figure B-1. Logs of the borings are presented as Figures B-2 through B-7. Laboratory compaction tests were performed on two near-surface samples are presented in this Appendix.

Percolation tests were performed in Borings P-1 through P-4 to evaluate the infiltration rate. Borings P-1 and P-2 were located at the northwest corner of the site and P-3 and P-4 were located at the southeast corner of the site. The test holes were presoaked at the completion of drilling (May 15, 2017) by filling each hole with about 12 to 18 inches of water. This water level was maintained for about 4 hours. The water was then allowed to infiltrate overnight to generate a "wetted zone" prior to testing. The following day (May 16, 2017), it was observed that the presoak water had dissipated into the subsurface in most of the explorations, except P-3. Water was then added to each of the holes to a depth approximately 12 to 14 inches above the bottom of the hole. The depth to water from a fixed point at the surface was noted. Depth measurements were then collected on a regular interval. The last measurement is used to calculate the infiltration rate. An electronic sounder was used to make the depth measurements to the accuracy of 1/100th of a foot in order to measure the amount of drop (or percolation).

The electrical resistivity surveys were performed by GEOVision and consisted of two survey traverses performed at the approximate locations shown on Figure 2. The surveys were performed using the 4 pin Wenner array method. A report presenting the methodology and the results is included at the end of this Appendix.

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Key to Logs** Sheet

Elevation, feet	Depth, feet	SAMPLES Type	Number		Graphic Log	MATERIAL DESCRIPTION	Dry Density, pcf	Dry Density, pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to NAVD88 or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number. Unnumbered sample indicates no sample recovery. "1-1" indicates geotechnical sample. "(B-1@1')" indicates analytical sample.

5 **Blows per foot:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop.

6 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

7 **Material Description:** Description of material encountered; may include relative density/consistency, moisture, color, particle size; texture, weathering, and strength of formation material. If shown, designation in parentheses denotes Munsell color classification.

8 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

9 **Dry Unit Weight:** Dry unit weight of soil sample measured in laboratory, in pounds per cubic foot.

10 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

SA	Sieve analysis, %<#200 sieve
WA	Three-point wash sieve, %<#200 sieve
LL	Liquid limit (from Atterberg limits test), %
PI	Plasticity Index [LL - PL], %; NP=nonplastic
CORR	Corrosivity Test suite
COMP	Compaction Curve (ASTM 1557D)
R-Value	R-Value test
THER	Thermal Resistivity Test (IEEE 442)

TYPICAL MATERIAL GRAPHIC SYMBOLS

Silty SAND (SM)   Clayey SAND (SC)   Sandy CLAY (CL)   Well-graded SAND (SW)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Standard Penetration Sampler

Bulk Sample

OTHER GRAPHIC SYMBOLS

▽ First water encountered at time of drilling and sampling (ATD)

▼ Static water level measured in boring or well at specified time after drilling

Change in material properties within a lithologic stratum

— — Inferred contact between strata or gradational change in lithology

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Report: GEO_10_SNA_KEY; File 60544320_FALLBROOKADDBORINGS.GPJ; 5/26/2017 key

AECOM

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Log of Boring B-1** Sheet 1 of 1

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	9.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	816 feet
Water Level Depth	Not Encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	Soil Cuttings	Location	N: 33.38438, W: -117.23557		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					<u>Fill</u> Moist, dark brown silty SAND (SM), with trace roots			
815									
			1	10		<u>Completely Weathered Granitic Rock</u> excavates to: loose, moist, dark brownish yellow silty SAND (SM)			
	5					<u>Highly Weathered Granitic Rock</u> excavates to: very dense, moist, dark brownish yellow silty SAND (SM), some oxidation			
810			2	71					
			3	72 6"		Becomes dark grayish brown			
	10					Bottom of boring at 9.5'			
805									
	15								
800									
	20								
795									
	25								

Report: GEO_10_SNA; File: 60544320_FALLBROOKADDBORINGS.GPJ; 5/26/2017 B-1

AECOM

Figure B-2

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2
Project Location: Fallbrook, CA
Project Number: 60544320.10000

Log of Boring B-2

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	9.5 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	802 feet
Water Level Depth	Not Encountered	Sampling Method(s)	SPT	Hammer Data	140lbs/30inch drop, auto hammer
Borehole Completion	Soil Cuttings	Location	N: 33.38443 W: -117.23489		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Fill** Moist, dark brown silty SAND (SM), with trace roots			
800									
						Residual Soil Loose, moist, reddish brown clayey SAND (SC)			
		SPT	1	6					
						Completely Weathered Granitic Rock excavates to: very dense, moist, brownish yellow well-graded SAND (SW)			
	5	SPT	2	75					
795									
		SPT	3	79 5"					
	10					Bottom of boring at 9.5'			
790									
	15								
785									
	20								
780									
	25								

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Log of Boring P-1** Sheet 1 of 1

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	5.0 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	802 feet
Water Level Depth	Not Encountered	Sampling Method(s)	Grab	Hammer Data	NA
Borehole Completion	Soil Cuttings	Location	N: 33.38465, W: -117.23618		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					Fill Moist, dark brown silty SAND (SM), with trace roots			
800						Residual Soil Moist, light brown clayey SAND with silt (SC), with trace gravel			
	5	☒	1						
						Bottom of boring at 5.0'			
795									
	10								
790									
	15								
785									
	20								
780									
	25								

AECOM

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Log of Boring P-2** Sheet 1 of 1

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	5.0 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	805 feet
Water Level Depth	Not Encountered	Sampling Method(s)	Grab	Hammer Data	NA
Borehole Completion	Soil Cuttings	Location	N: 33.38448, W: -117.23626		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
805	0					**Fill** Moist, dark brown silty SAND (SM), with trace roots			
		⊠	1						
						Residual Soil Moist, light brown clayey SAND with silt (SC)			
		⊠	2						
800	5					Bottom of boring at 5.0'			
795	10								
790	15								
785	20								
780	25								

Report: GEO_10_SNA; File 60544320_FALLBROOKADDBORINGS.GPJ; 5/26/2017 P-2

AECOM

Figure B-5

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Log of Boring P-3** Sheet 1 of 1

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	5.0 feet
Drill Rig Type	Marl M5, Truck mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	791 feet
Water Level Depth	Not Encountered	Sampling Method(s)	Grab	Hammer Data	NA
Borehole Completion	Soil Cuttings	Location	N: 33.38402, W: -117.23438		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					Fill Moist, dark brown silty SAND (SM), with trace roots			
790		☒	1						
						Residual Soil Moist, reddish brown clayey SAND (SC)/sandy CLAY (CL)			
	5	☒	2						
						Bottom of boring at 5.0'			
785									
	10								
780									
	15								
775									
	20								
770									
	25								

AECOM

Figure B-6

Project: SDG&E Fallbrook Battery Storage Project; Parcel 2 Project Location: Fallbrook, CA Project Number: 60544320.10000	**Log of Boring P-4** Sheet 1 of 1

Date(s) Drilled	5/15/17	Logged By	Ryan Bourdette	Checked By	
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	6-inch Finger Bit	Total Depth of Borehole	5.0 feet
Drill Rig Type	Marl M5, Truck Mounted	Drilling Contractor	Pacific Drilling	Approximate Surface Elevation	791 feet
Water Level Depth	Not Encountered	Sampling Method(s)	Grab	Hammer Data	NA
Borehole Completion	Soil Cuttings	Location	N: 33.38392, W: -117.23446		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	0					**Fill** Moist, dark brown silty SAND (SM), with trace gravel and roots			
790									
		☒	1						
						Residual Soil Moist, dark reddish brown clayey SAND (SC)/sandy CLAY (CL)			
	5	☒	2						
						Bottom of boring at 5.0'			
785									
	10								
780									
	15								
775									
	20								
770									
	25								

Report: GEO_10_SNA File: 60544320_FALLBROOKADDBORINGS.GPJ 5/26/2017 P-4

AECOM

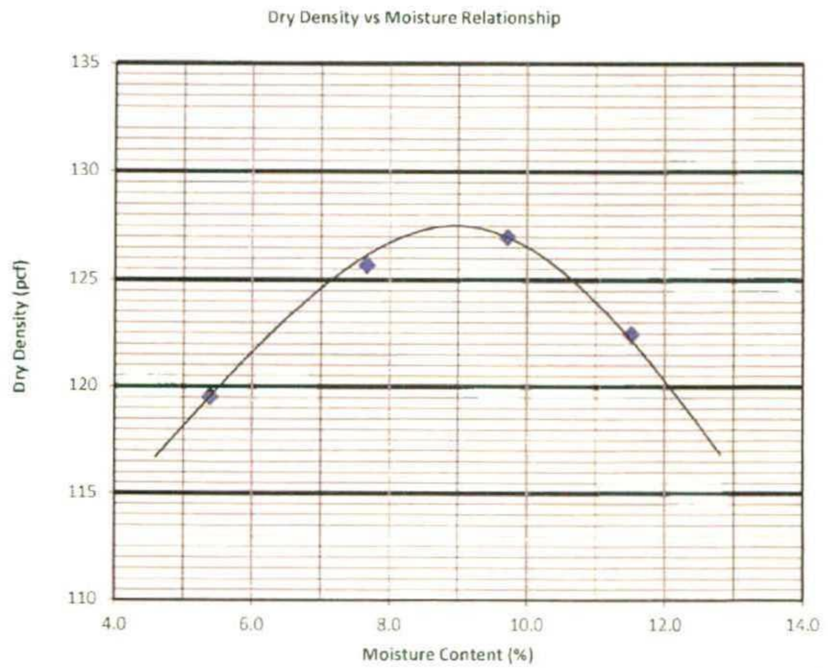
REPORT OF MOISTURE/DENSITY RELATIONSHIP TEST

(ASTM D1557/D698)

Date:	July 28, 2017	Job Number:	60544320.1 / 962
Client:	Aecom	Report Number:	5255
Address:	4225 Executive Square, Suite 1400 La Jolla, CA 92037	Lab Number:	114470

Project:	Fallbrook Additional Borings		
Project Address:	Fallbrook, CA		
Material:	Dark Brown silty SAND (SM)	Mold Size:	4 inch
Material Source:	NR		
Location:	Bulk 1	ASTM D1557	A
Date Sampled:	7/20/2017		
Date Submitted:	7/20/2017		
Sampled By:	Client (RB)		

Maximum Dry Density = 127.5 pcf **Optimum Moisture = 9.0%**



Distribution

Client

File

Reviewed By:

Sam Koohi, PE

Engineering Manager

N|V|5

REPORT OF MOISTURE/DENSITY RELATIONSHIP TEST

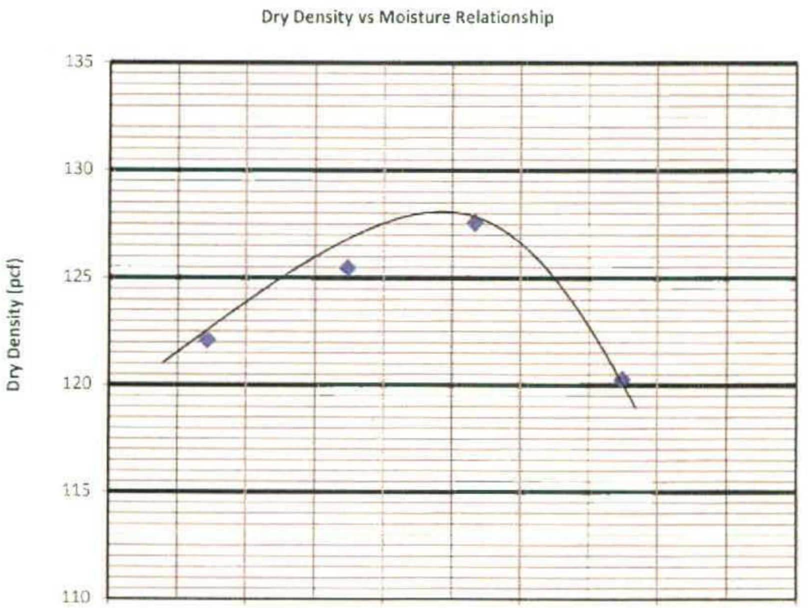
(ASTM D1557/D698)

Date:	July 28, 2017	Job Number:	60544320.1 / 962
Client:	Aecom	Report Number:	5255
Address:	4225 Executive Square, Suite 1400 La Jolla, CA 92037	Lab Number:	114471

Project:	Fallbrook Additional Borings		
Project Address:	Fallbrook, CA		
Material:	Brown silty SAND (SM)	Mold Size:	4 inch
Material Source:	NR		
Location:	Bulk 3	ASTM D1557	A
Date Sampled:	7/20/2017		
Date Submitted:	7/20/2017		
Sampled By:	Client (RB)		

Maximum Dry Density = 128.0 pcf

Optimum Moisture = 9.0%



Distribution

Client

File

Reviewed By:

Sam Koohi, PE

Engineering Manager

Fallbrook Additional Borings
Fallbrook, California
Percolation Test Data

B-1			Description		Boring Diameter / Boring Depth	7 / 5.00	inches / feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
5/15/2017	Pre-soak	1:54 PM	0	NA	NA	NA	NA
	add water						
5/16/2017	Add Water	9:43 AM	0	NA	NA	NA	NA
		10:13 AM	30	0.23	10.9	5.52	3.89E-03
	Add Water	10:16 AM	0	NA	NA	NA	NA
		10:51 AM	35	0.51	5.7	10.49	7.40E-03
	Add Water	10:52 AM	0	NA	NA	NA	NA
		11:20 AM	28	0.36	6.5	9.26	6.53E-03
	Add Water	11:27 AM	0	NA	NA	NA	NA
		11:57 AM	30	0.35	7.1	8.40	5.93E-03
	Add Water	11:58 AM	0	NA	NA	NA	NA
		12:37 PM	39	0.38	8.6	7.02	4.95E-03
	Add Water	12:41 PM	0	NA	NA	NA	NA
		1:17 PM	36	0.56	5.4	11.20	7.90E-03
	Add Water	1:19 PM	0	NA	NA	NA	NA
		1:56 PM	37	0.30	10.3	5.84	4.12E-03
				CASE III: last reading =	10.3	5.84	4.12E-03
			Adjusted percolation Rate =		21.9	12.44	8.78E-03

B-2			Description		Boring Diameter / Boring Depth	7 / 5.00	inches / feet
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
5/15/2017	Pre-soak	3:14 PM	0	NA	NA	NA	NA
	add water						
5/16/2017	Add Water	9:35 AM	0	NA	NA	NA	NA
		10:09 AM	34	0.26	10.9	5.51	3.88E-03
	Add Water	10:11 AM	0	NA	NA	NA	NA
		10:47 AM	36	0.26	11.5	5.20	3.67E-03
	Add Water	10:48 AM	0	NA	NA	NA	NA
		11:18 AM	30	0.19	13.2	4.56	3.22E-03
	Add Water	11:22 AM	0	NA	NA	NA	NA
		11:53 AM	31	0.30	8.6	6.97	4.92E-03
		12:32 PM	39	0.23	14.1	4.25	3.00E-03
	Add Water	12:35 PM	0	NA	NA	NA	NA
		1:13 PM	38	0.24	13.2	4.55	3.21E-03
	Add Water	1:15 PM	0	NA	NA	NA	NA
		1:41 PM	26	0.18	12.0	4.98	3.52E-03
				CASE III: last reading =	12.0	4.98	3.52E-03
			Adjusted percolation Rate =		25.6	10.62	7.49E-03

Infiltration Rate
Per Porchet Method

B-1: I = 0.57 in/hr

B-2: I = 0.42 in/hr

Porchet Method Calculation Example (B-1)

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$ — ΔH = 3.6 inches

r - radius of boring — r = 3.5 inches

t - time — Δt = 37 min

H_{avg} - average height of last 2 readings — H_{avg} = 16.08 inches

Porchet Method Calculation Example (B-2)

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$ — ΔH = 2.16 inches

r - radius of boring — r = 3.5 inches

t - time — Δt = 26 min

H_{avg} - average height of last 2 readings — H_{avg} = 18.84 inches

B-1

Initial DTW (ft)	Final DTW (ft)
3.51	3.81

17.88 H_0
14.28 H_f
3.6 Delta H (inches)
16.08 H_{avg} (inches)

B-2

Initial DTW (ft)	Final DTW (ft)
3.34	3.52

19.92 H_0
17.76 H_f
2.16 Delta H (inches)
18.84 H_{avg} (inches)

Adjustment Factor for Gravel Packed Holes

Void Ratio, n: 0.35
Hole Diameter, D_H: 7 in
Pipe Diameter, D_P: 3 in

$$AF = \frac{D_H^2}{D_P^2 + n\,(D_H^2 - D_P^2)}$$

Adjustment Factor, AF: 2.13

Fallbrook Additional Borings
Fallbrook, California
Percolation Test Data

B-5			Description	Boring Diameter	7	inches	
				Boring Depth	5.00	feet	
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
5/15/2017	Pre-soak	4:16 PM	0	NA	NA	NA	NA
	add water						
5/16/2017	Add Water	9:55 AM	0	NA	NA	NA	NA
		10:32 AM	37	0.000	NA	NA	NA
		11:04 AM	32	0.005	533.3	0.11	7.94E-05
		11:33 AM	29	-0.005	NA	NA	NA
		12:11 PM	38	0.005	633.3	0.09	6.68E-05
		12:54 PM	43	0.005	716.7	0.08	5.91E-05
		1:34 PM	40	0.000	NA	NA	NA
		2:17 PM	43	0.010	358.3	0.17	1.18E-04
CASE I: slower of last two readings =					**716.7**	**0.08**	**5.91E-05**

Adjusted percolation Rate = 1526.8 0.18 1.26E-04

B-6			Description	Boring Diameter	7	inches	
				Boring Depth	5.00	feet	
Date	Note	Time	Elapsed Time (mins)	Drop (feet)	Perc Rate (mpi)	Perc Rate (in/hr)	Perc Rate (cm/sec)
5/15/2017	Pre-soak	5:21 PM	0	NA	NA	NA	NA
	add water						
5/16/2017	Add Water	10:02 AM	0	NA	NA	NA	NA
		10:35 AM	33	-0.04	NA	NA	NA
		11:07 AM	32	0.04	66.7	0.90	6.35E-04
		11:39 AM	32	0.05	53.3	1.13	7.94E-04
		12:14 PM	35	0.04	72.9	0.82	5.81E-04
	Add Water	12:17 PM	0	NA	NA	NA	NA
		12:56 PM	39	0.06	54.2	1.11	7.82E-04
		1:36 PM	40	0.05	66.7	0.90	6.35E-04
		2:20 PM	44	0.06	61.1	0.98	6.93E-04
CASE I: slower of last two readings =					**66.7**	**0.90**	**6.35E-04**

Adjusted percolation Rate = 142.0 1.92 1.35E-03

Infiltration Rate
Per Porchet Method

B-5: I = **0.004 in/hr**

B-6: I = **0.08 in/hr**

B-5

Porchet Method Calculation Example

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$	ΔH =	0.06	inches
r - radius of boring	r =	3.5	inches
t - time	Δt =	43	min
H_{avg} - average height of last 2 readings	H_{avg} =	33.63	inches

Initial DTW (ft)	Final DTW (ft)
2.195	2.20

33.66 H_0
33.6 H_f
0.06 Delta H (inches)
33.63 H_{avg} (inches)

B-6

Porchet Method Calculation Example

$I = \Delta H(60r)/(\Delta t(r+2H_{avg}))$	ΔH =	0.6	inches
r - radius of boring	r =	3.5	inches
t - time	Δt =	40	min
H_{avg} - average height of last 2 readings	H_{avg} =	18.18	inches

Initial DTW (ft)	Final DTW (ft)
3.46	3.51

18.48 H_0
17.88 H_f
0.6 Delta H (inches)
18.18 H_{avg} (inches)

Adjustment Factor for Gravel Packed Holes

Void Ratio, n	0.35	
Hole Diameter, D_H	7.00	in
Pipe Diameter, D_P	3	in
Adjustment Factor, AF:	2.13	

$$AF = \frac{D_H^2}{D_P^2 + n(D_H^2 - D_P^2)}$$

GEOVision
geophysical services

July 24, 2017

Project Number 17263

Pallavi Kumar, P.E.
AECOM
4225 Executive Square
Suite 1400
La Jolla, CA 92037
858-812-9292

Subject: **Four-Electrode Resistivity Survey**
Fallbrook, California

Mrs. Pallavi Kumar:

A geophysical survey was conducted on July 20, 2017 at the project site in Fallbrook, California. The purpose of the geophysical survey was to map the subsurface electrical structure of the approximate 300 ft by 600 ft site, per ASTM Standard G 57. The site consisted of a fenced orchard covered with brush, vegetation, and some farming facilities.

Resistivity data were collected in two distinct locations, Res 1 and Res 2. At each location data were acquired along two orthogonal profiles, one oriented approximately south to north and one oriented approximately west to east. Soundings were concentric, the center point being the GPS point provided on Table 1. AECOM preselected the approximate sounding locations which allowed the use of conventional a-spacings to a maximum of 100 ft. **GEO***Vision* staff obtained sounding center locations using a Trimble ProXRS submeter GPS system with Omnistar differential corrections (Table 1).

Table 1: Resistivity Soundings Location (Center point)

Location	Northing (Feet)	Easting (Feet)
Res 1	2084849.374	6260723.047
Res 2	2084886.443	6261022.618

Note: Coordinates in California State Plane, Zone VI (0406)
NAD83, in US Survey Feet

EQUIPMENT AND METHODOLOGY

Resistivity equipment used during this investigation included a L and R Instruments, Inc. MiniRes Ultra 8 - 2.5 Hz Resistivity Meter/IP earth resistivity meter coupled to 3/8-inch stainless steel electrode stakes with 18 gauge insulated copper wire. A test resistor, rated at 19.82 ohms at 25 degrees Celsius, was used to verify that the MiniRes meter was operating within manufacturer specifications.

Resistivity data were acquired using a four electrode array, specifically the Wenner Array. The generalized form of the four-electrode array is shown in Figure 1.

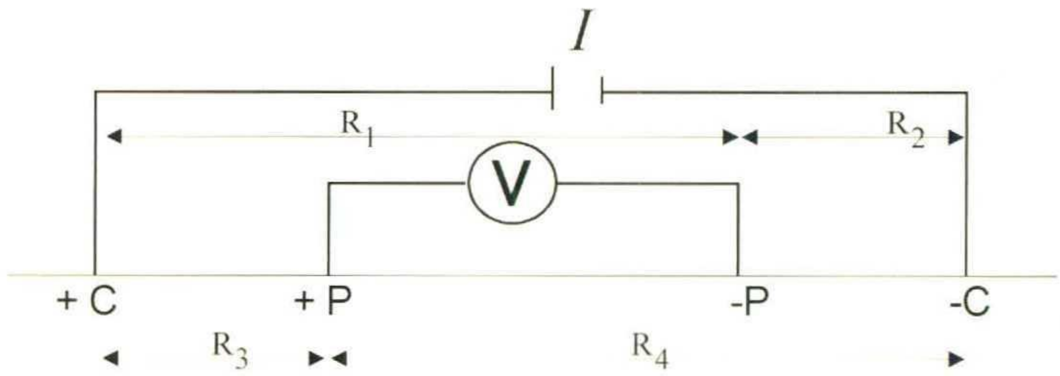


Figure 1: The generalized form of the four electrode array (Wenner Array – R2=R3, R1=2R3, R4=2R2).

When the material upon which the current is induced is uniform, the resistivity calculated will be constant independent of electrode configuration. However, in a field investigation where subsurface heterogeneities exist, the calculated resistivity values will vary with electrode array. This calculated resistivity is referred to as apparent resistivity (ρ_a), and can be calculated using the relationship:

$$\rho_a = \frac{2\pi V}{I\left\{(\frac{1}{R_3} - \frac{1}{R_4}) - (\frac{1}{R_1} - \frac{1}{R_2})\right\}}$$

For the Wenner array, which was used during this investigation, where R1 = R4; R3 = R2 and R1 = 2R2 = $2a$, it can be shown that the formula for calculated apparent resistivity can be reduced to the following form:

$$\rho_a = 2\pi a\left(\frac{V}{I}\right).$$

FIELD PROCEDURES

Before conducting the geophysical survey, battery levels were checked on the resistivity meter and general site conditions were recorded on the field log.

Resistivity measurements were made using the Wenner Array (Figure 1). The Wenner Array uses a constant spacing between the four electrodes (a-spacing). AECOM specified the approximate sounding locations which allowed for nine electrode spacings (1.5, 3, 5, 7.5, 15, 30, 50, 75, and 100 feet) in the north-south direction and in the east-west direction. All electrode locations were established using 300-ft fiberglass survey tapes.

A test resistor, rated at 19.82 ohms at 25 degrees Celsius, was connected to the positive and negative current and potential leads on the MiniRes meter immediately before and after each sounding. The resistance value across the test resistor and the time of the test measurement was recorded on the field log.

For each resistivity measurement, four stainless steel electrodes were placed at array specified distances (a-spacing) in a straight line. A current was applied from the outer electrodes, and the potential difference (voltage) was measured across the inner electrodes. The MiniRes meter displayed the resistance value equal to V/I. This value was recorded, along with the a-spacing, on a field data sheet and later transferred to a spreadsheet. Two measurements were recorded at each station for quality control. If there was significant variation between the first and second measurements, the control leads, electrode cable and electrode coupling were field verified to ensure proper coupling then the measurement was repeated. After each measurement, the electrodes were moved to the next a-spacing and another set of measurements was taken.

DATA REDUCTION

Resistivity data were reduced using a spreadsheet. Electrode spacing (a-spacing) and resistance reading (V/I) were entered into the spreadsheet for each resistivity measurement and apparent resistivity (also referred to as calculated magnitude) were calculated using the aforementioned formula. Apparent resistivity values were also calculated for the repeat measurements and presented in units of ohm-feet, ohm-meters and ohm-centimeters.

RESULTS

Data collected from four Wenner resistivity soundings are attached as Tables 2, Table 3, Table 4, and Table 5. All calculations were conducted using known geometry and measured resistance (V/I) values which were recorded in the field logs. Apparent resistivity (magnitude) values are presented in ohm-ft, ohm-m and ohm-cm. The ASTM Standard G57-06 specifies that apparent resistivity (magnitude) is presented in the ohm-centimeter unit. All completed data processing forms are retained in project files.

Calculated resistivity values for the perpendicular soundings were similar, all generally increasing at larger a-spacing. Orthogonal soundings at R1 (Table 2 and Table 3) are consistent, showing a relatively resistive upper section, underlain by a more conductive zone, then a gradual increase in resistivity at depth. Sounding R2 WE (Table 4) and R2 SN (Table 5) exhibited more of a consistent general increase of resistivity with depth. The variability between R1 and R2 may be due to slightly dryer near surface material at R1.

SUMMARY

Four-electrode soil resistivity measurements were made at two client specified locations, consisting of four soundings, at the site in Fallbrook, California in accordance with ASTM standard G57-06. Apparent soil resistivity values were acquired at nine electrode spacings for all four soundings. Field measurements and calculated values were consistent and repeatable at all locations, as summarized in Tables 2 through Table 4.

If you have any questions concerning this investigation, please call us at 951-549-1234.

Sincerely,

GEO*Vision* Geophysical Services

Submitted by:	Reviewed and Approved by:
Jonathan Jordan	Victor Gonzalez
Senior Staff Geophysicist	Senior Geophysicist, PG, PGp

Attachments:

Table 2: Resistivity Sounding R1 WE
Table 3: Resistivity Sounding R1 SN
Table 4: Resistivity Sounding R2 WE
Table 5: Resistivity Sounding R2 SN

TABLE 2: RESISTIVITY SOUNDING R1 WE

Job Number: 17263 Date: 7/20/2017 Temperature: Approx 80 °F

19.82 ohm Test Resistor Reading Rated at 83 °F (25 °C)

Test Resistance	Repeat	Time
19.82 ohm	19.82 ohm	0933
19.84 ohm	19.82 ohm	1005

A-Spacing	Resistance Reading	Geometric Multiplier	Calculated Magnitude	Converted Magnitude	Calculated to Ohm-cm	Repeat Resistance	Repeat Magnitude	Repeat Conversion	Repeat Calculation to Ohm-cm
[ft.]	[Ohm]	[2(pi)A]	[Ohm-ft.]	[Ohm-m]	[Ohm-cm]	[Ohm]	[Ohm-ft.]	[Ohm-m]	[Ohm-cm]
1.5	58.900	9.4	555.1	169.2	16920.0	59	556.1	169.5	16948.8
3.0	18.200	18.8	343.1	104.6	10456.5	18.2	343.1	104.6	10456.5
5.0	6.740	31.4	211.7	64.5	6453.9	6.73	211.4	64.4	6444.4
7.5	3.760	47.1	177.2	54.0	5400.6	3.79	178.6	54.4	5443.7
15.0	2.270	94.2	213.9	65.2	6521.0	2.273	214.2	65.3	6529.6
30.0	1.197	188.5	225.6	68.8	6877.2	1.197	225.6	68.8	6877.2
50.0	0.833	314.2	261.7	79.8	7976.5	0.833	261.7	79.8	7976.5
75.0	0.730	471.2	344.0	104.9	10485.3	0.731	344.5	105.0	10499.6
100.0	0.437	628.3	274.6	83.7	8369.1	0.437	274.6	83.7	8369.1

TABLE 3: RESISTIVITY SOUNDING R1 SN

Job Number: 17263 Date: 7/20/2017 Temperature: Approx 85 °F

19.82 ohm Test Resistor Reading Rated at 83 °F (25 °C)

Test Resistance	Repeat	Time
19.82 ohm	19.82 ohm	1015
19.82 ohm	19.82 ohm	1045

A-Spacing [ft.]	Resistance Reading [Ohm]	Geometric Multiplier [2(pi)A]	Calculated Magnitude [Ohm-ft.]	Converted Magnitude [Ohm-m]	Calculated to Ohm-cm [Ohm-cm]	Repeat Resistance [Ohm]	Repeat Magnitude [Ohm-ft.]	Repeat Conversion [Ohm-m]	Repeat Calculation to Ohm-cm [Ohm-cm]
1.5	32.700	9.4	308.2	93.9	9393.6	32.600	307.2	93.6	9364.9
3.0	12.060	18.8	227.3	69.3	6928.9	12.250	230.9	70.4	7038.0
5.0	5.790	31.4	181.9	55.4	5544.3	5.795	182.1	55.5	5549.0
7.5	4.362	47.1	205.6	62.7	6265.3	4.361	205.5	62.6	6263.9
15.0	2.355	94.2	222.0	67.7	6765.1	2.364	222.8	67.9	6791.0
30.0	1.238	188.5	233.4	71.1	7112.7	1.238	233.4	71.1	7112.7
50.0	0.875	314.2	274.9	83.8	8378.6	0.875	274.9	83.8	8378.6
75.0	0.566	471.2	266.7	81.3	8129.7	0.567	267.2	81.4	8144.0
100.0	0.460	628.3	289.0	88.1	8809.5	0.460	289.0	88.1	8809.5

TABLE 4: RESISTIVITY SOUNDING R2 WE

Job Number: 17263 Date: 7/20/2017 Temperature: Approx 90 °F

19.82 ohm Test Resistor Reading Rated at 83 °F (25 °C)

Test Resistance	Repeat	Time
19.82 ohm	19.82 ohm	1144
19.79 ohm	19.81 ohm	1218

A-Spacing [ft.]	Resistance Reading [Ohm]	Geometric Multiplier [2(pi)A]	Calculated Magnitude [Ohm-ft.]	Converted Magnitude [Ohm-m]	Calculated to Ohm-cm [Ohm-cm]	Repeat Resistance [Ohm]	Repeat Magnitude [Ohm-ft.]	Repeat Conversion [Ohm-m]	Repeat Calculation to Ohm-cm [Ohm-cm]
1.5	20.1	9.4	189.4	57.7	5774.1	20.100	189.4	57.7	5774.1
3.0	9.1	18.8	171.5	52.3	5228.3	9.080	171.2	52.2	5216.8
5.0	6.303	31.4	198.0	60.4	6035.5	6.302	198.0	60.3	6034.5
7.5	4.106	47.1	193.5	59.0	5897.6	4.104	193.4	58.9	5894.7
15.0	2.424	94.2	228.5	69.6	6963.4	2.424	228.5	69.6	6963.4
30.0	1.211	188.5	228.3	69.6	6957.6	1.212	228.5	69.6	6963.4
50.0	0.774	314.2	243.2	74.1	7411.5	0.775	243.5	74.2	7421.1
75.0	0.609	471.2	287.0	87.5	8747.3	0.611	287.9	87.8	8776.0
100.0	0.537	628.3	337.4	102.8	10284.2	0.534	335.5	102.3	10226.7

TABLE 5: RESISTIVITY SOUNDING R2 SN

Job Number: 17263 Date: 7/20/2017 Temperature: Approx 95 °F

19.82 ohm Test Resistor Reading Rated at 83 °F (25 °C)

Test Resistance	Repeat	Time
19.80 ohm	19.80 ohm	1230
19.80 ohm	19.80 ohm	1247

A-Spacing [ft.]	Resistance Reading [Ohm]	Geometric Multiplier [2(pi)A]	Calculated Magnitude [Ohm-ft.]	Converted Magnitude [Ohm-m]	Calculated to Ohm-cm [Ohm-cm]	Repeat Resistance [Ohm]	Repeat Magnitude [Ohm-ft.]	Repeat Conversion [Ohm-m]	Repeat Calculation to Ohm-cm [Ohm-cm]
1.5	53.400	9.4	503.3	153.4	15340.1	53.100	500.5	152.5	15253.9
3.0	9.316	18.8	175.6	53.5	5352.4	9.315	175.6	53.5	5351.8
5.0	6.278	31.4	197.2	60.1	6011.5	6.280	197.3	60.1	6013.5
7.5	3.803	47.1	179.2	54.6	5462.4	3.803	179.2	54.6	5462.4
15.0	2.268	94.2	213.8	65.2	6515.2	2.267	213.7	65.1	6512.3
30.0	1.321	188.5	249.0	75.9	7589.6	1.320	248.8	75.8	7583.9
50.0	0.803	314.2	252.3	76.9	7689.2	0.803	252.3	76.9	7689.2
75.0	0.586	471.2	276.1	84.2	8416.9	0.586	276.1	84.2	8416.9
100.0	0.490	628.3	307.9	93.8	9384.1	0.490	307.9	93.8	9384.1