Converse Consultants
Geotechnical Engineering
Environmental & Groundwater Science
Inspection & Testing Services

GEOTECHNICAL INVESTIGATION REPORT

EMWD LOS ALAMOS HILLS PIPELINE PROJECT

City of Murrieta, Riverside County, California

CONVERSE PROJECT NO. 22-81-144-02

Prepared For:

WEBB ASSOCIATES
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Presented By:

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November 28, 2022

Converse Consultants

Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

November 28, 2022

Mr. Bradley Sackett, PE
Senior Engineer
Webb Associates
3788 McCray Street
Riverside, CA 92506

Subject: **GEOTECHNICAL INVESTIGATION REPORT**
EMWD LOS ALAMOS HILLS PIPELINE PROJECT
City of Murrieta, Riverside County, California
Converse Project No. 22-81-144-02

Dear Mr. Sackett:

Converse Consultants (Converse) is pleased to submit this Geotechnical Investigation Report for the EMWD Los Alamos Hills Project, located in the City of Murrieta, Riverside County, California. This report was prepared in accordance with our proposal dated June 21, 2022, and your Single-Project Subconsultant Agreement (Project Code: 2022-0143) dated August 22, 2022.

Based upon our field investigation, laboratory data, and analyses, the proposed project is considered feasible from a geotechnical standpoint, provided the recommendations presented in this report are incorporated into the design and construction of the project.

We appreciate the opportunity to be of service to Webb Associates (WEBB) and the Eastern Municipal Water District (EMWD). Should you have any questions, please do not hesitate to contact us at 909-474-2847.

CONVERSE CONSULTANTS

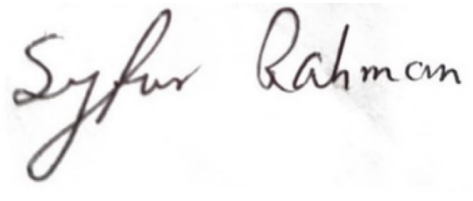
Hashmi S. E. Quazi, PhD, PE, GE
Principal Engineer

Dist.: 1-Electronic pdf/Addressee
HSQ/RG/MS/CN/SR/kvg

PROFESSIONAL CERTIFICATION

This report has been prepared by the following professionals whose seals and signatures appear herein.

The findings, recommendations, specifications and professional opinions contained in this report were prepared in accordance with the generally accepted professional engineering and engineering geologic principle and practice in this area of Southern California. We make no other warranty, either expressed or implied.



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1.0 INTRODUCTION

This report presents the results of our geotechnical investigation performed by Converse for the EMWD Los Alamos Hills project, located in the City of Murrieta, Riverside County, California. The pipeline alignments are shown in Figure No. 1, *Approximate Alignments Locations Map*.

The purpose of this investigation is to determine the nature and engineering properties of the subsurface soils, and to provide preliminary design and construction recommendations for the project.

This report is prepared for the project described herein and is intended for use solely by WEBB and EMWD and their authorized agents for design purposes. It should not be used as a bidding document but may be made available to the potential contractors for information on factual data only. For bidding purposes, the contractors should be responsible for making their own interpretation of the data contained in this report.

2.0 PROJECT DESCRIPTION

The pipeline alignments being considered for the project are summarized in the following table.

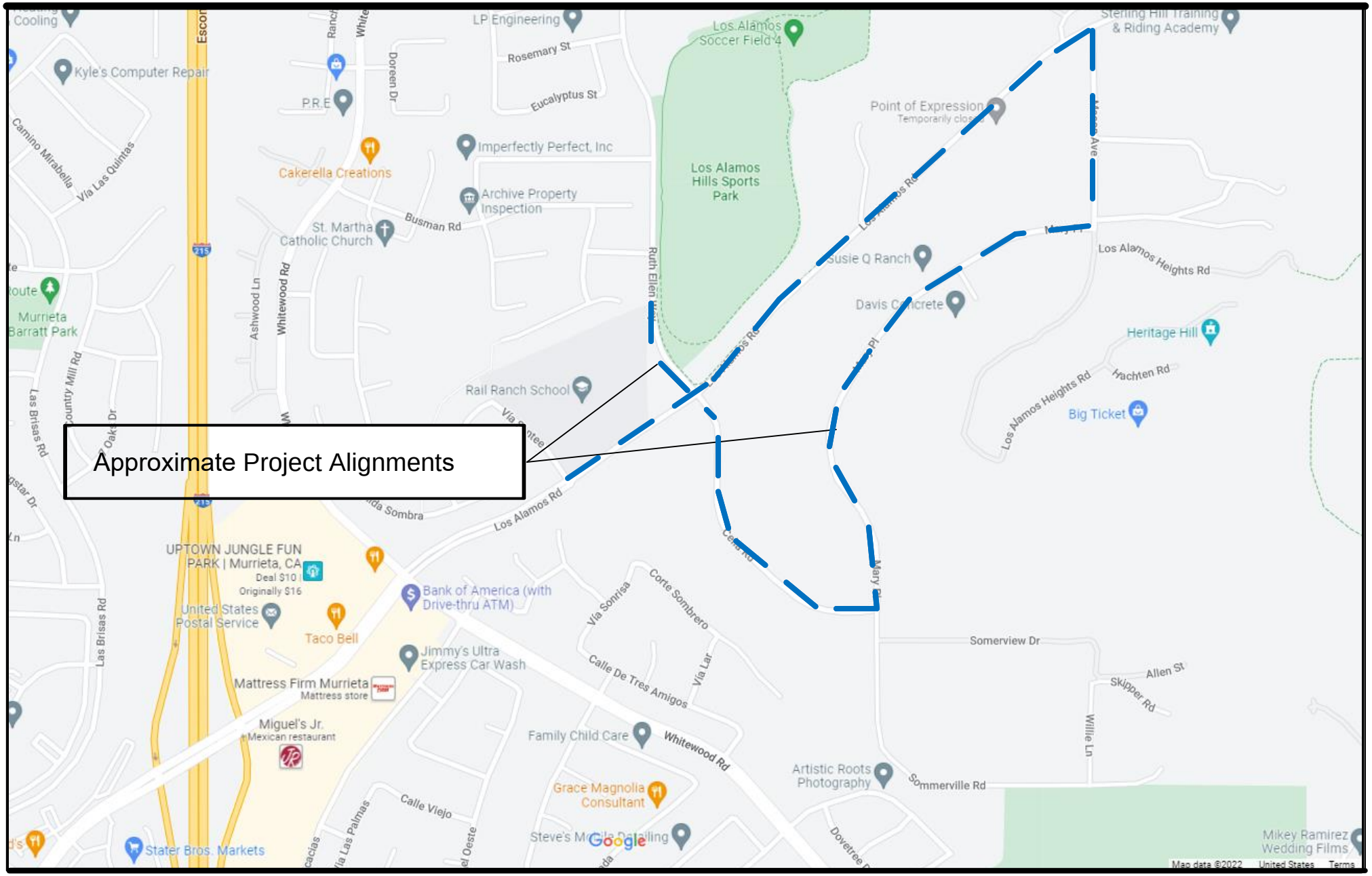
Table No. 1, Summary of the Pipelines Alignments

Site/Alignment	Location From	Location to	Approximate Distance (feet)
Los Alamos Road	Via Santee	Mason Avenue	4,280
Ruth Ellen Way	Approximately 670 feet North of Los Alamos Road	Los Alamos Road	670
Celia Road	Los Alamos Road	Mary Place	2,010
Mary Place	Celia Road	Mason Avenue	4,000
Mason Avenue	Mary Place	Los Alamos Road	1,240
Note: For each alignment location, refer to Figure No. 1, *Approximate Alignments Locations Map.*			

The available project plans are preliminary; therefore, project information described herein is subject to change if the project plans change.

3.0 ALIGNMENTS CONDITIONS

The surface conditions of the major streets along the pipeline alignments are described below.



Project: EMWD Los Alamos Hills
Location: City of Murrieta, Riverside County, California

Approximate Alignments Locations Map

Project No.
22-81-144-02

For: Webb Associates

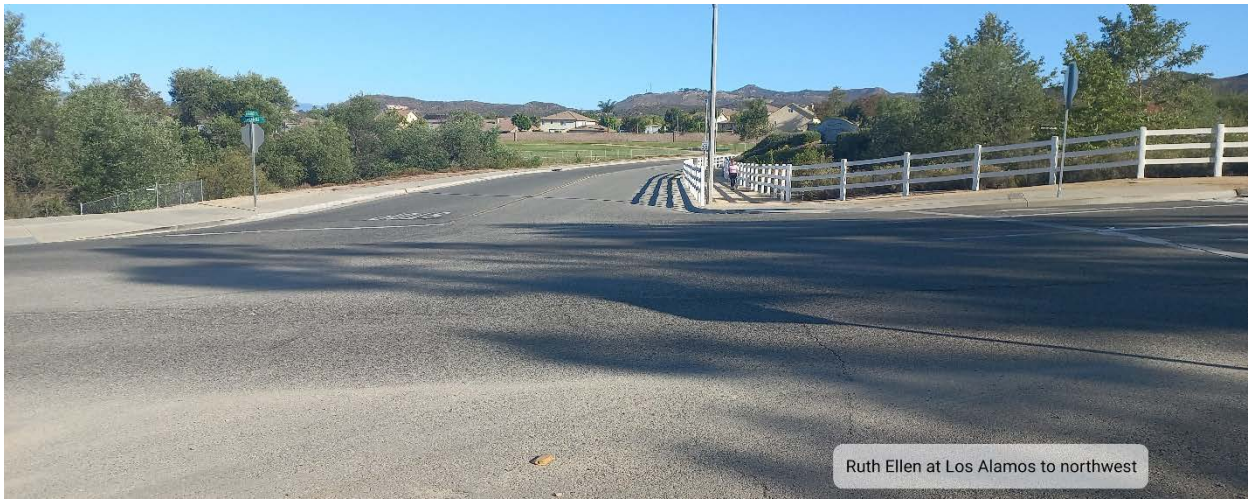
Converse Consultants

Figure No.
1

a. <u>Ruth Ellen Way: Beginning of Pipeline Alignments on Ruth Ellen Way to Los Alamos Road (approx. 670 feet)</u>

- Bounded on west by Rail Ranch School Yard and drainage basin and to the east by a slope to Los Alamos Hills Sports Park.
- Paved road with single lane in each direction with shoulders, but no center painted median. The width of the road is approximately 45 feet.
- Sidewalk on west side of road with horse trail on the east.
- Overhanging streetlights.
- Parking lane on west side.
- Light traffic was observed.
- Professional traffic control was required.
- Drilling required the closure of the shoulder.
- Refer to Photograph Nos. 1 and 2.

Photograph No. 1: Ruth Ellen Way at beginning of pipeline alignments BH-02, facing south.



Photograph No. 2: Ruth Ellen Way at Los Alamos Road, facing north.

b. *Los Alamos Road: Via Santee to Mason Avenue (approx. 4,280 feet)*

- Bounded on the north from Via Santee to Ruth Ellen Way by Rail Ranch School and a residential property, then from Ruth Ellen Way by Los Alamos Hills Sports Park for approximately 1,100 feet, then residential horse property to Mason Avenue, and the south by residential horse property and vacant land.
- Paved road with 1 lane in each direction with no shoulders or center painted median. The width of the road is approximately 30 feet.
- No overhead utilities or streetlights.
- Moderate traffic was observed.
- Professional traffic control was required.
- Drilling required the closure of the shoulder.
- Refer to Photograph Nos. 3 through 6.

Photograph No. 3: Los Alamos Road at Ruth Ellen Way, facing northeast.

Photograph No. 4: Los Alamos Road BH-15, facing southwest.

Photograph No. 5: Los Alamos Road (BH-13), facing northeast.

Photograph No. 6: Los Alamos Road at Mason Avenue (BH-12), facing southwest.

c. ***Celia Road: Los Alamos Road to Mary Place (approx. 2.020 feet)***

- Bounded on both sides by residential horse property.
- Graded dirt road with single lane in each direction. The width of the road is approximately 25 feet.
- The posted speed limit sign is 15 miles per hour (mph).
- No overhead or overhanging streetlights.
- Light traffic was observed.

- No professional traffic control was required.
- Drilling required the closure of the shoulder.
- Refer to Photograph Nos. 7 and 8.

Photograph No. 7: Celia Road at Los Alamos Road BH-03, facing southeast.

Photograph No. 8: Celia Road at Mary Place BH-05, facing west.

d. <u>Mary Place: Celia Road to Mason Avenue (approx. 4,000 feet)</u>

- Bounded on both sides by residential horse property.

- Graded dirt road with single lane in each direction. The width of the road is approximately 25 feet.
- Light traffic was observed.
- No professional traffic control required.
- Drilling required the closure of the shoulder.
- Refer to Photograph Nos. 9 through 10.

Photograph No. 9: Mary Place at Celia Road, facing north.

Photograph No. 10: Mary Place (BH-07), facing southwest.

e. *Mason Avenue: Los Alamos Road to Mary Place (approx. 1,240 feet)*

- Bounded on both sides by residential horse property.

- Heavily worn paved road with single lane in each direction. The width of the road is approximately 15 feet.
- The posted speed limit sign is 10 miles per hour (mph).
- No overhead utilities or streetlights.
- Light traffic was observed.
- No professional traffic control was required.
- Drilling required the closure of the shoulder.
- Refer Photograph Nos. 11 and 12.

Photograph No. 11: Mason Avenue at Los Alamos Road, facing south.

Photograph No. 12: Mason Avenue at Mary Place, facing north.

4.0 SCOPE OF WORK

The scope of this investigation included project set-up, subsurface exploration, laboratory testing, engineering analysis, and preparation of this report, as described in the following sections.

4.1 Document Review

We reviewed the following available documents.

- Reports and data provided by WEBB and EMWD.
- Desktop study report prepared by Converse Consultants, dated June 1, 2022.
- Regional and local geology literature and maps.
- Flood hazards maps.
- Arial photos.
- Faulting and seismicity, and any other documents that pertain to the sites or the vicinity.
- Groundwater data.

4.2 Project Set-up

The project set-up consisted of the following tasks.

- Prepared a boring locations map and submitted it to Brad Sackett with WEBB for review and approval.
- Conducted alignments reconnaissance and marked the borings at locations approved by Bradly Sackett with WEBB.
- Obtained encroachment permit to drill along Los Alamos Road and Ruth Ellen Way from the Public Works & Engineering Department, City of Murrieta.
- Prepared required traffic control plans.
- Notified Underground Service Alert (USA) at least 48 hours prior to drilling to clear the boring locations of any conflict with existing underground utilities.
- Engaged a California-licensed driller to drill exploratory borings.
- Engaged a Professional Traffic Control company.

4.3 Subsurface Exploration

Fifteen exploratory borings (BH-01 through BH-15) were drilled on October 18, and October 19, 2022, along the pipeline alignments to investigate subsurface conditions. The borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. The details of borings are presented in the following table.

Table No. 2, Summary of the Borings

Boring No.	Location	Boring Depth (ft, bgs)		Groundwater Depth (ft, bgs)	Date Completed
		Proposed	Completed		
BH-01	Los Alamos Road[t]	10.0	5.0**	N/E	10/19/2022
BH-02	Ruth Ellen Way[t]	10.0	11.5	N/E	10/19/2022
BH-03	Celia Road	10.0	11.4	N/E	10/18/2021
BH-04	Celia Road	10.0	6.0*	N/E	10/18/2021
BH-05	Celia Road	10.0	6.5*	N/E	10/18/2021
BH-06	Mary Place	10.0	10.3	N/E	10/18/2021
BH-07	Mary Place	10.0	10.3	N/E	10/18/2021
BH-08	Mary Place	10.0	10.6	N/E	10/18/2021
BH-09	Mary Place	10.0	11.5	N/E	10/18/2021
BH-10	Mason Avenue[v]	10.0	10.5	N/E	10/18/2021
BH-11	Mason Avenue[v]	10.0	10.9	N/E	10/18/2021
BH-12	Los Alamos Road[t]	10.0	10.3	N/E	10/19/2022
BH-13	Los Alamos Road[t]	10.0	11.3	N/E	10/19/2022
BH-14	Los Alamos Road[t]	10.0	10.4	N/E	10/19/2022
BH-15	Los Alamos Road[t]	10.0	10.2	N/E	10/19/2022

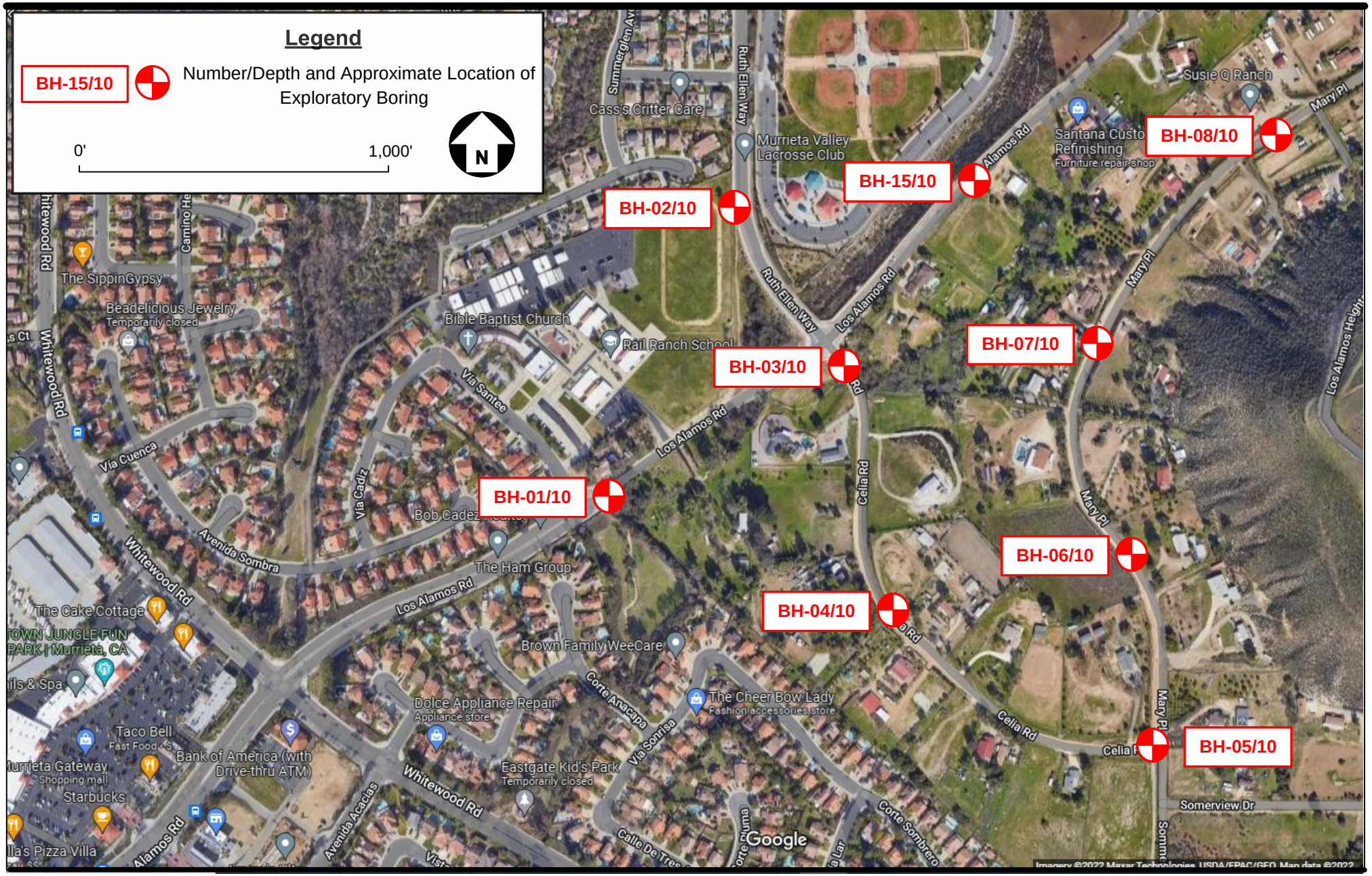
Note: - NE = not encountered.
*Refusal due to large concentration of aggregate.
**Refusal due to potential utility conflict.
t=pavement cored, and core replaced with Pro Select Anchoring Adhesive and dyed black to match road surface.
v= pavement drilled directly into and patched with cold patch asphalt concrete.

The approximate locations of the borings are shown on Figure Nos. 2a and 2b, *Approximate Boring Locations Map*. A detailed discussion of the subsurface exploration is presented in Appendix A, *Field Exploration*.

4.4 Laboratory Testing

Representative soil samples were tested in the laboratory to aid in the soils classification and to evaluate the relevant engineering properties of the soil. These tests included the following.

- *In*-situ moisture contents and dry densities (ASTM D2216 and ASTM D2937)
- Sand Equivalent (ASTM D2419)
- Soil corrosivity (California Tests 643, 422, and 417)



Project: EMWD Los Alamos Hills
Location: City of Murietta, Riverside County, California

For: Webb Associates

Approximate Boring Locations Map

Project No.
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Converse Consultants

Figure No.
2a

Project: EMWD Los Alamos Hills
Location: City of Murietta, Riverside County, California

For: Webb Associates

Approximate Boring Locations Map

Project No.
22-81-144-02

Converse Consultants

Figure No.
2b

- Grain size distribution (ASTM D6913)
- Maximum dry density and optimum-moisture content (ASTM D1557)
- Direct shear (ASTM D3080)

For *in-situ* moisture and dry density data, see the Logs of Boring in Appendix A, *Field Exploration*. For a description of the laboratory test methods and test results, see Appendix B, *Laboratory Testing Program.*

4.5 Analysis and Report Preparation

Data obtained from the field exploration and laboratory testing program was compiled and evaluated. Geotechnical analyses of the compiled data were performed, and this report was prepared to present our findings, conclusions, and recommendations for the project.

5.0 SURFACE AND SUBSURFACE CONDITIONS

A general description of the surface and subsurface conditions, various materials and groundwater conditions encountered at each location during our field exploration is discussed below.

5.1 Existing Pavement Sections

The measured pavement thicknesses at each boring location are listed in the following table.

Table No. 3, Existing Pavement Sections

Boring No.	Street/Location	Asphalt Concrete Thickness (in.)	Aggregate Base Thickness (in.)
BH-01	Los Alamos Road	6.0	4.0
BH-02	Ruth Ellen Way	4.0	9.0
BH-03*	Celia Road	N/A	N/A
BH-04*	Celia Road	N/A	N/A
BH-05*	Celia Road	N/A	N/A
BH-06*	Mary Place	N/A	N/A
BH-07*	Mary Place	N/A	N/A
BH-08*	Mary Place	N/A	N/A
BH-09*	Mary Place	N/A	N/A
BH-10	Mason Avenue	4.0	3.0
BH-11	Mason Avenue	2.0	4.0

Boring No.	Street/Location	Asphalt Concrete Thickness (in.)	Aggregate Base Thickness (in.)
BH-12	Los Alamos Road	5.0	2.0
BH-13	Los Alamos Road	5.0	4.0
BH-14	Los Alamos Road	5.0	4.0
BH-15	Los Alamos Road	5.0	2.0

Note:
For location of the borings, see Figure Nos. 2a and 2b, *Approximate Boring Locations Map* and *Table No. 2, Summary of Boring.*
*Drilled on dirt.

For a detailed description of the subsurface materials encountered in the exploratory borings, see Drawings No. A-2 through A-16, *Logs of Borings,* in Appendix A, *Field Exploration.*

5.2 Subsurface Profile

The subsurface profile to the depths of borings is described below.

Undocumented Artificial Fill: Undocumented artificial fill was encountered in all borings from the surface and below the asphalt concrete to a depth ranging from 0.5 feet to 5.0 feet below ground surface (bgs). Based on the exploratory borings and laboratory test results, the subsurface fill soils consist primarily of a mixture of sand, silt, occasional gravel and cobbles. Scattered to little gravel up to 3 inch in largest dimension, and scattered cobbles up to 8 inches in maximum dimension were observed in the borings.

Alluvium: The alluvium was encountered in all borings below the undocumented artificial fill at depths ranging from 0.5 to 5.0 feet bgs. Based on the exploratory borings and laboratory test results, the subsurface alluvium soils consist primarily of a mixture of sand, silt, clay, occasional gravel and occasional cobble. Scattered to little gravel up to 3 inch in largest dimension were observed in the borings.

5.3 Groundwater

Groundwater was not encountered during the field investigation.

Current and historical groundwater data was reviewed near the proposed pipeline alignment. Results from the searches are provided below.

The State Water Resources Control Board's GeoTracker Database (SWRCB, 2022) was reviewed for current and historic groundwater level data within a 1.0-mile radius of the

project area. Data from that search is listed below.

- Shell Service Station (Site No. T0606581892), located approximately 2,800 feet southwest of the project area, reported groundwater at depths ranging from approximately 17.63 to 40.12 feet bgs between 2003 and 2009.
- Mobil Service Station (Site No. T0606540445), located approximately 4,330 feet southwest of the project area, reported groundwater at depths ranging from approximately 54.84 to 58.01 feet bgs between 2005 and 2009.
- Las Brisas Cleaners (Site No. SL0607300208) located approximately 4,500 feet southwest of the project area, reported groundwater at depths ranging from approximately 55.07 to 62.10 feet bgs between 2006 and 2011.

The National Water Information System (USGS, 2022) was reviewed for current and historical groundwater data from sites within an approximately 1.0-mile radius of the pipeline alignments and the results of that search are included below.

Table No. 4, Summary of USGS Groundwater Depth Data

Site Number	Location	Groundwater Depth Range (ft. bgs)	Date Range
333501117095201	Los Alamos Road along pipeline alignment 1	30.00	1968
333512117092701	Approximately 4,500 feet east of Mason Avenue	43.00	1968
333440117101501	Approximately 300 feet west of Celia Road	12.00	1968
333442117102101	Approximately 800 feet west of the intersection of Los Alamos and Celia Road	34.00	1968
333533117091401	Approximately 2,500 feet northeast of the intersection of Los Alamos and Mason Avenue	23.00	1968
333529117093401	Approximately 2,300 feet northeast of the intersection of Los Alamos and Mason Avenue	10.00	1968
333532117100001	Approximately 2,800 feet northwest of the intersection of Los Alamos and Mason Avenue	9.00	1968
333506117102901	Approximately 2,000 feet northwest of the beginning of pipeline Alignment on Ruth Ellen Way	6.00	1968

The California Department of Water Resources database (DWR, 2022) was reviewed for historical groundwater data from sites within a 1.0-mile radius of the project site. No site, which is not listed above, with groundwater data was found within a 1.0-mile radius of the project site.

Historically high groundwater along the pipeline alignments is not known with certainty but is anticipated to be deeper than approximately 6.0 feet bgs. However, under certain conditions the groundwater may be at or above ground surface, e.g., periods of flooding or proximity to a stream.

It should be noted that the groundwater levels could vary depending upon the seasonal precipitation and possible groundwater pumping activity in the alignment vicinity. Shallow perched groundwater may be present locally, particularly following precipitation.

5.4 Excavatability

The subsurface soil materials are expected to be excavatable by conventional heavy-duty earth moving and trenching equipment. Excavation will likely be difficult where concentration of gravel and cobbles are encountered.

The phrase “conventional heavy-duty excavation equipment” is intended to include commonly used equipment such as excavators and trenching machines. It does not include hydraulic hammers (“breakers”), jackhammers, blasting, or other specialized equipment and techniques used to excavate hard earth materials. Selection of an appropriate excavation equipment model should be done by an experienced earthwork contractor and may require test excavations in representative areas.

5.5 Subsurface Variations

Based on results of the subsurface exploration and our experience, some variations in the continuity and nature of subsurface conditions within the pipeline alignments should be anticipated. Because of the uncertainties involved in the nature and depositional characteristics of the earth material, care should be exercised in interpolating or extrapolating subsurface conditions between or beyond the boring locations.

6.0 ENGINEERING GEOLOGY

The regional and local geology are discussed in the following subsections.

6.1 Regional Geology

The pipeline alignments are located within the northern Peninsular Ranges Geomorphic Province of Southern California. The Peninsular Ranges Geomorphic Province consists of a series of northwest-trending mountain ranges and valleys bounded on the north by the San Bernardino and San Gabriel Mountains, on the west by the Los Angeles Basin, and on the south by the Pacific Ocean.

The province is a seismically active region characterized by a series of northwest-trending strike-slip faults. The most prominent of the nearby fault zones include the San Jacinto, Cucamonga, and San Andreas Fault Zones, all of which have been known to be active during Quaternary time.

Topography within the province is generally characterized by broad alluvial valleys separated by linear mountain ranges. This northwest-trending linear fabric is created by the regional faulting within the granitic basement rock of the Southern California Batholith. Broad, linear, alluvial valleys have been formed by erosion of these principally granitic mountain ranges.

The project area is located within the Perris Block. The Perris Block is a relatively stable structural block bounded by the active Elsinore and San Jacinto fault zones to the west and east, and the Chino and Temecula basins to the north and south, respectively. The Perris Block has low relief and is roughly rectangular.

6.2 Local Geology

The project area is anticipated to be underlain by Cretaceous age undifferentiated hornblende gabbro (Kgb) to the southwest. The northeastern portion of the project area is anticipated to be underlain by Sandstone, moderately to well indurated, containing scattered cobble to boulder conglomerate (Qps) beds. Bedrock is anticipated to be encountered within the project area.

6.3 Flooding

Review of National Flood Insurance Rate Maps indicate that the pipeline alignments are located within a Flood Hazard Zone "X". The zone “X” is designated as an area with a 0.2 percent annual chance flood hazard. (FEMA, 2008).

7.0 FAULTING AND SEISMICITY

Nearby active faults, seismicity, and their impact on the project area are discussed in the following sections.

7.1 Faulting

The proposed pipeline alignments are situated in a seismically active region. As is the case for most areas of Southern California, ground-shaking resulting from earthquakes associated with nearby and more distant faults may occur at the project site. During the life of the project, seismic activity associated with active faults can be expected to generate moderate to strong ground shaking at the site. Review of recent seismological and geophysical publications indicates that the seismic hazard for the project is high.

No portion of the project area is located within a currently designated State of California or Riverside County Earthquake Fault Zone (CGS, 2007; Riverside County, 2022). The nearest active fault zone is the Murrieta Hot Springs fault zone approximately 1,400 feet south of the intersection of Celia Road and Mary Place. The nearest fault is the Warm Springs Fault approximately 400 feet south of the intersection of Celia Road and Mary Place. The Elsinore Fault Zone is approximately 2.35 miles southwest of the Celia Road and Mary Place intersection.

The table below summarizes selected data of known faults capable of seismic activity within 100 kilometers of the site. We used the generalized coordinates of 33.5809N, 117.16724W, for the fault table below. The data presented below was calculated using the National Seismic Hazard Maps Database (USGS, 2008) and other published geologic data.

Table No. 5, Summary of Regional Faults

Fault Name and Section	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
Elsinore	4.25	strike slip	241	n/a	7.85
San Jacinto	28.96	strike slip	241	n/a	7.88
Chino, alt 2	45.81	strike slip	29	1	6.80
Chino, alt 1	49.97	strike slip	24	1	6.70
Newport Inglewood Connected alt 1	50.25	strike slip	208	1.3	7.50
Newport Inglewood Connected alt 2	50.25	strike slip	208	1.3	7.50
Newport-Inglewood (Offshore)	50.25	strike slip	66	1.5	7.00
S. San Andreas	52.83	strike slip	548	n/a	8.18
Rose Canyon	56.17	strike slip	70	1.5	6.90
Pinto Mtn	66.84	strike slip	74	2.5	7.30
Earthquake Valley	69.93	strike slip	20	2	6.80
Cucamonga	70.91	thrust	28	5	6.70

Fault Name and Section	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
Newport-Inglewood, alt 1	71.33	strike slip	65	1	7.20
Puente Hills (Coyote Hills)	73.85	thrust	17	0.7	6.90
Coronado Bank	75.01	strike slip	186	3	7.40
Palos Verdes Connected	75.01	strike slip	285	3	7.70
San Jose	76.43	strike slip	20	0.5	6.70
Palos Verdes	77.38	strike slip	99	3	7.30
Cleghorn	77.39	strike slip	25	3	6.80
Sierra Madre	80.22	reverse	57	2	7.20
Sierra Madre Connected	80.22	reverse	76	2	7.30
Burnt Mtn	81.9	strike slip	21	0.6	6.80
North Frontal (West)	82.2	reverse	50	1	7.20
Eureka Peak	87.21	strike slip	19	0.6	6.70
Puente Hills (Santa Fe Springs)	87.93	thrust	11	0.7	6.70
Helendale-So Lockhart	88.68	strike slip	114	0.6	7.40
North Frontal (East)	90.44	thrust	27	0.5	7.00
Landers	94.87	strike slip	95	0.6	7.40
Clamshell-Sawpit	96.41	reverse	16	0.5	6.70
Lenwood-Lockhart-Old Woman Springs	98.06	strike slip	145	0.9	7.50
Puente Hills (LA)	98.75	thrust	22	0.7	7.00
Raymond	99.88	strike slip	22	1.5	6.80

(Source: https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/)

7.2 *CBC Seismic Design Parameters*

Seismic parameters based on the 2022 California Building Code (CBSC, 2022) and ASCE 7-16 are provided in the following table. These parameters were determined using the generalized coordinates (33.5809N, 117.16724W) and the Seismic Design Maps ATC online tool.

Table No. 6, CBC 2022 Seismic Design Parameters

Seismic Parameters	
Site Coordinates	33.5809N, 117.16724W
Site Class	D*
Risk Category	III

Seismic Parameters	
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_s	1.494g
Mapped 1-second Spectral Response Acceleration, S_1	0.558g
Site Coefficient (from Table 11.4-1), F_a	1.0
Site Coefficient (from Table 11.4-2), F_v	1.8
MCE 0.2-sec period Spectral Response Acceleration, S_{MS}	1.494g
MCE 1-second period Spectral Response Acceleration, SM_1	1.004g
Design Spectral Response Acceleration for short period S_{DS}	0.996g
Design Spectral Response Acceleration for 1-second period, S_{D1}	0.670g
Site Modified Maximum Peak Ground Acceleration, PGA_M	0.717g

** Stiff Soil Classification*

7.3 Secondary Effects of Seismic Activity

Generally, in addition to ground shaking, effects of seismic activity on a pipeline or structure may include surface fault rupture, soil liquefaction, and settlement due to earthquake shaking, landslides, lateral spreading, tsunamis, seiches, and flooding due to earthquake-induced dam failure. The site-specific potential for each of these seismic hazards is discussed in the following sections.

Surface Fault Rupture: No portions of the project area are located within a currently designated State of California or Riverside County Earthquake Fault Zone (CGS, 2007; Riverside County, 2022). The potential for surface rupture resulting from the movement of nearby or distant faults is not known with certainty but is considered very low.

Dynamic Settlement (Liquefaction and Dry Seismic Settlement): Liquefaction is defined as the phenomenon in which a soil mass within about the upper 50 feet of the ground surface suffers a substantial reduction in its shear strength, due the development of excess pore pressures. During earthquakes, excess pore pressures in saturated soil deposits may develop as a result of induced cyclic shear stresses, resulting in liquefaction.

Soil liquefaction occurs during or after strong ground shaking. There are several requirements for liquefaction to occur. They are as follows.

- Soils must be submerged
- Soils must be loose to medium-dense
- Ground motion must be intense
- Duration of shaking must be sufficient for the soils to lose shear resistance

There is a very low risk for liquefaction along Ruth Ellen Way, Los Alamos Road, Mason Avenue and the northeastern section of Mary Place. Celia Road and the southwest section of Mary Place there is no risk for liquefaction. Dynamic settlement should be evaluated with data from the soil borings to be conducted during the geotechnical investigation phase

Landslides and Lateral Spreading: Seismically induced landslides and other slope failures are common occurrences during or after earthquakes in areas of significant relief. No portions of the project area are located within a currently designated State of California or Riverside County Landslide Zone (CGS, 2007; Riverside County, 2022). Seismically induced lateral spreading involves primarily lateral movement of earth materials due to ground shaking. The potential for landslides or lateral spreading at the project area is considered very low.

Tsunamis: Tsunamis are large waves generated in open bodies of water by fault displacement or major ground movement. Due to the inland location of the pipeline alignments, tsunamis are not considered to be a risk.

Seiches: Seiches are large waves generated in enclosed bodies of water in response to ground shaking. There are no enclosed bodies of water near the pipeline alignments. Seiching is not considered to be a risk during construction.

Earthquake-Induced Flooding: Dams or other water-retaining structures may fail as a result of large earthquakes. The pipeline alignments are not located within a designated dam inundation area (DSOD, 2022).

8.0 LABORATORY TEST RESULTS

Results of physical and chemical tests performed for this project are presented below.

8.1 Physical Testing

Physical test results for alignments are presented in the following table. For detailed description of these tests, see Appendix B, *Laboratory Testing Program,* except for the results of in-situ moisture and dry density tests which are presented on the Logs of Borings in Appendix A, *Field Exploration*.

Table No. 7, Physical Properties of Soils

Test	Values				
	Los Alamos BH01, BH-12 to BH-15	Ruth Ellen BH-02	Celia Way BH-03 to BH-05	Mary Place BH-06 to BH-09	Mason BH-10, BH-11
*In-situ Moisture and Dry Density (ASTM D2216 and ASTM D2937)	94 to 135 pcf and 3 to 10 percent	103 to 132 pcf and 9 to 11 percent	90 to 127 pcf and 2 to 23 percent	110 to 138 pcf and 1 to 12 percent	107 to 128 pcf and 5 to 11 percent
Sand Equivalent (ASTM D2419)	21.0 to 34.0	N/T	N/T	23	29
Gran Size Analysis (ASTM D6913)	SM	SM	SM with gravel	SM	SM
Maximum Dry Density and Optimum Moisture Content (ASTM D1557)	131.0 pcf and 4.8 percent	N/T	136.0 pcf and 4.4 percent	135.0 pcf and 7.2 percent	N/T
Direct Shear (ASTM D3080)	C= 200 psf and ϕ = 36	N/T	C= 110 to 400 psf and ϕ= 31 to 41	C= 290 psf and ϕ = 31	C= 250 psf and ϕ = 30

Note:
1.N/T = Not Tested, SM = Silty Sand,
2.*Moisture and dry density for upper 10 feet
3. C = cohesion, ϕ = angle of internal friction

8.2 Chemical Testing - Corrosivity Evaluation

Four representative soil samples were tested to determine minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The purposes of these tests were to determine the corrosion potential of soils when placed in contact with common pipe and construction materials. These tests were performed by AP Engineering and Testing, Inc. (Pomona, CA) in accordance with Caltrans Test Methods 643, 422 and 417. The test results are summarized in the following table.

Table No. 8, Summary of Corrosivity Test Results

Boring No.	Street	Depth (feet)	pH	Soluble Sulfates (CA 417) (ppm)	Soluble Chlorides (CA 422) (ppm)	Min. Resistivity (CA 643) (Ohm-cm)
BH-03	Celia Way at Celia Way	5.0-10.0	7.6	35	26	2,107
BH-05	Celia Way at Mary Place	0 – 5.0	7.4	38	27	2,208
BH-08	Mary Place.	5.0 – 10.0	7.4	16	19	10,248
BH-11	Mason Avenue	0.5 – 5.0	7.3	35	24	2,045

9.0 TRENCH BACKFILL RECOMMENDATIONS

Recommendations of backfill for pipe trenching are presented in the following subsections.

9.1 General

Prior to the start of construction, all existing underground utilities and appurtenances should be located within the vicinity of the proposed alignments. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications. All excavations should be conducted in such a manner as not to cause loss of bearing and/or lateral support of existing structures or utilities.

All debris, deleterious material, and surficial soils containing roots and perishable materials should be stripped and removed from the alignments. Deleterious material, including organics, concrete, and debris generated during excavation, should not be placed as fill.

Migration of fines from the surrounding native soils, in the case of water leak from the pipe, must be considered in selecting the gradation of the materials placed within the trench, including bedding, pipe zone and trench zone backfill, as defined in the following sections. Such migration of fines may deteriorate pipe support and may result in settlement/ground loss at the surface.

It should be the responsibility of the contractor to maintain safe working conditions during all phases of construction.

Observations and field tests should be performed by the project soils consultant to confirm that the required degree of compaction has been obtained. Where compaction is less than specified, additional compactive effort should be made with adjustment of the moisture content as necessary, until the specified compaction is obtained.

9.2 Pipeline Subgrade Preparation

The final subgrade surface should be level, firm, uniform, free of loose materials, and properly graded to provide uniform bearing and support to the entire section of the pipe placed on bedding material. Protruding oversize particles, larger than 3 inches maximum dimension, should be removed from the trench bottom and replaced with compacted on-alignments materials.

Any loose, soft and/or unsuitable materials encountered at the pipe sub-grade should be removed and replaced with an adequate bedding material.

During the digging of depressions for proper sealing of the pipe joints, the pipe should rest on a prepared bottom for as near its full length as is practicable.

9.3 Pipe Bedding

Bedding is defined as the material supporting and surrounding the pipe to 1 foot above the pipe. Pipe bedding should follow EMWD or City of Murrieta Standards, whichever is applicable. Additional information for pipe bedding is provided below.

To provide uniform and firm support for the pipe, compacted granular materials such as clean sand, gravel or ¾-inch crushed aggregate, or crushed rock may be used as pipe bedding material. The sand equivalents of the tested soils were between 21 and 34. Typically, soils with sand equivalent value of 30 or more are used as pipe bedding material. The pipe designer should determine if the soils are suitable as pipe bedding material.

The type and thickness of the granular bedding placed underneath and around the pipe, if any, should be selected by the pipe designer. The load on the rigid pipes and deflection of flexible pipes and, hence, the pipe design, depends on the type and the amount of bedding placed underneath and around the pipe.

Bedding materials should be vibrated in-place to achieve compaction. Care should be taken to densify the bedding material below the springline of the pipe. Prior to placing the pipe bedding material, the pipe subgrade should be uniform and properly graded to provide uniform bearing and support to the entire section of the pipe placed on bedding

material. During the digging of depressions for proper sealing of the pipe joints, the pipe should rest on a prepared bottom for as near its full length as is practicable.

Migration of fines from the surrounding native and/or fill soils must be considered in selecting the gradation of any imported bedding material. We recommend that the pipe bedding material should satisfy the following criteria to protect migration of fine materials.

i. $\frac{D15(F)}{D85(B)} \leq 5$

ii. $\frac{D50(F)}{D50(B)} < 25$

iii. Bedding Materials must have less than 5 percent passing No. 200 sieve (0.0074 mm) to avoid internal movement of fines.

Where,
F = Bedding Material
B = Surrounding Native and/or Fill Soils
*D*15(F) = Particle size through which 15% of bedding material will pass
*D*85(B) = Particle size through which 85% of surrounding soil will pass
*D*50(F) = Particle size through which 50% of bedding material will pass
*D*50(B) = Particle size through which 50% of surrounding soil will pass

If the above criteria do not satisfy, commercially available geofabric used for filtration purposes (such as Mirafi 140N or equivalent) may be wrapped around the bedding material encasing the pipe to separate the bedding material from the surrounding native or fill soils.

9.4 Backfill Materials

No fill should be placed until excavations and/or natural ground preparation have been observed by the geotechnical consultant. Excavated soils should be processed, including removal of roots and debris, removal of oversized particles, mixing, and moisture conditioning, before placing as compacted fill. On-site soils used as fill should meet the following criteria.

- No particles larger than 3 inches in largest dimension.
- Rocks larger than one inch should not be placed within the upper 12 inches of subgrade soils.
- Free of all organic matter, debris, or other deleterious material.
- Expansion index of 30 or less.
- Sand Equivalent greater than 15 (greater than 30 for pipe bedding).
- Contain less than 40 percent fines (passing #200 sieve).

Imported materials, if required, should meet the above criteria prior to being used as compacted fill. Any imported fills should be tested and approved by geotechnical representative prior to delivery to the construction site.

9.5 Compacted Fill Placement

Fill soils should be thoroughly mixed, and moisture conditioned to within ±3 percent of optimum moisture content for coarse soils and 0 to 2 percent above optimum moisture content for fine soils and compacted to at least 90 percent of the laboratory maximum dry density.

Fill materials should not be placed, spread or compacted during unfavorable weather conditions. When work is interrupted by heavy rain, filling operations should not resume until the geotechnical consultant approves the moisture and density conditions of the previously placed fill.

9.6 Trench Zone Backfill

The trench zone is defined as the portion of the trench above the pipe bedding extending up to the final grade level of the trench surface. Excavated on-site soils free of oversize particles and deleterious matter may be used to backfill the trench zone. Trench backfill should follow EMWD or City of Murrieta Standards, whichever is applicable. Additional trench backfill recommendations are presented below.

- Trench excavations to receive backfill should be free of trash, debris or other unsatisfactory materials at the time of backfill placement.
- Trench zone backfill should be compacted to at least 90 percent of the laboratory maximum dry density as per ASTM D1557 test method. At least the upper 1 foot of trench backfill underlying pavement should be compacted to at least 95 percent of the laboratory maximum dry density as per ASTM D1557 test method.
- Particles larger than 1 inch should not be placed within 12 inches of the pavement subgrade. No more than 30 percent of the backfill volume should be larger than ¾-inch in the largest dimension. Gravel should be well mixed with finer soil. Rocks larger than 3 inches in the largest dimension should not be placed as trench backfill.
- Trench backfill should be compacted by mechanical methods, such as sheepsfoot, vibrating or pneumatic rollers or mechanical tampers to achieve the density specified herein. The backfill materials should be brought to within ± 3 percent of optimum moisture content for coarse-grained soil, and between optimum and 2 percent above optimum for fine-grained soil, then placed in horizontal layers. The thickness of uncompacted layers should not exceed 8 inches. Each layer should

be evenly spread, moistened or dried as necessary, and then tamped or rolled until the specified density has been achieved.

- The contractor should select the equipment and processes to be used to achieve the specified density without damage to adjacent ground, structures, utilities and completed work.
- The field density of the compacted soil should be measured by the ASTM D1556 (Sand Cone) or ASTM D6938 (Nuclear Gauge) or equivalent.
- Trench backfill should not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations should not resume until field tests by the project's geotechnical consultant indicate that the moisture content and density of the fill are in compliance with project specifications.

10.0 DESIGN RECOMMENDATIONS

General design recommendations, resistance to lateral loads, pipe design parameters, bearing pressures, and soil corrosivity are discussed in the following subsections.

10.1 General

Where pipes connect to rigid structures and are subjected to significant loads as the backfill is placed to finish grade, we recommend that provisions be incorporated in the design to provide support of these pipes where they exit the structures. Consideration can be given to flexible connections, concrete slurry support beneath the pipes where they exit the structures, overlaying the pipes with a few inches of compressible material, (i.e., Styrofoam, or other materials), or other techniques.

The various design recommendations provided in this section are based on the assumption that the above earthwork recommendations will be implemented.

10.2 Resistance to Lateral Loads

Resistance to lateral loads can be assumed to be provided by passive earth pressures and friction between construction materials and native soils. The resistance to lateral loads were estimated by using on-site native soils strength parameters obtained from laboratory testing. The resistance to lateral loads recommended for use in design of thrust blocks are presented in the following table.

Table No. 9, Resistance to Lateral Loads

Soil Parameters	Value
Passive earth pressure (psf per foot of depth)	250
Maximum allowable bearing pressure against native soils (psf)	2,500
Coefficient of friction between formed concrete and native soils, fs	0.35

10.3 Soil Parameters for Pipe Design

Structural design requires proper evaluation of all possible loads acting on pipe. The stresses and strains induced on buried pipe depend on many factors, including the type of soil, density, bearing pressure, angle of internal friction, coefficient of passive earth pressure, and coefficient of friction at the interface between the backfill and native soils. The recommended values of the various soil parameters for design are provided in the following table.

Table No. 10, Soil Parameters for Pipe Design

Soil Parameters	Value		
	Celia Road	Marry Place	Los Alamos Road
Average compacted fill total unit weight (assuming 92% relative compaction), γ (pcf)	131	133	126
Angle of internal friction of soils, ϕ	31	31	36
Soil cohesion, c (psf)	110	110	200
Coefficient of friction between concrete and native soils, fs	0.35	0.35	0.35
Coefficient of friction between PVC pipe and native soils, fs	0.25	0.25	0.25
Bearing pressure against native soils (psf)	2,500	2,500	2,500
Coefficient of passive earth pressure, Kp	3.12	3.12	3.85
Coefficient of active earth pressure, Ka	0.32	0.32	0.26
Modulus of Soil Reaction E' (psi)	1,500	1,500	1,500

Note
1. Celia Road = BH-03 through BH-05,
2. Marry Place = BH-06 through BH-09,
3. Los Alamos Road = BH-01 and BH-12 through BH-15

10.4 Bearing Pressure for Anchor and Thrust Blocks

An allowable net bearing pressure presented in Table No. 10, *Soil Parameters for Pipe Design* may be used for anchor and thrust block design against alluvial soils. Such thrust blocks should be at least 18 inches wide.

If normal code requirements are applied for design, the above recommended bearing capacity and passive resistances may be increased by 33 percent for short duration loading such as seismic or wind loading.

10.5 Soil Corrosivity

The results of chemical testing of four representative soil samples from the soil borings were evaluated for corrosivity evaluation with respect to common pipe and construction materials such as concrete and steel. The test results are presented in Appendix B, *Laboratory Testing Program,* and are discussed below.

The sulfate content of the sampled soil corresponds to American Concrete Institute (ACI) exposure category S0 for this sulfate concentration (ACI 318-14, Table 19.3.1.1). No concrete type restrictions are specified for exposure category S0 (ACI 318-14, Table 19.3.2.1). A minimum compressive strength of 2,500 psi is recommended.

We anticipate that the pipeline will be exposed to moisture from precipitation and irrigation. Based on the alignments location and the results of chloride testing of the soils, we do not anticipate pipeline will be exposed to external sources of chlorides, such as deicing chemicals, salt, brackish water, or seawater. ACI specifies exposure category C1 where concrete is exposed to moisture, but not to external sources of chlorides (ACI 318-14, Table 19.3.1.1). ACI provides concrete design recommendations in ACI 318-14, Table 19.3.2.1, including a compressive strength of at least 2,500 psi and a maximum chloride content of 0.3 percent.

According to Romanoff, 1957, the following table provides general guidelines of soil corrosion based on electrical resistivity.

Table No. 11, Correlation Between Resistivity and Corrosion

Soil Resistivity (ohm-cm) per Caltrans CT 643	Corrosivity Category
Over 10,000	Mildly corrosive
2,000 – 10,000	Moderately corrosive
1,000 – 2,000	corrosive
Less than 1,000	Severe corrosive

The minimum electrical resistivities along pipeline alignments when saturated ranged from 2,045 to 10,248 ohm-cm. These values indicate that the tested soils are moderately corrosive to ferrous metals in contact with the soils.

Converse does not practice in the area of corrosion consulting. If needed, a qualified corrosion consultant should provide appropriate corrosion mitigation measures for any ferrous metals in contact with the site soils.

11.0 CONSTRUCTION CONSIDERATIONS

Construction recommendations are presented below.

11.1 General

Prior to the start of construction, all existing underground utilities should be located along the pipeline alignments. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications.

Vertical braced excavations are feasible along the pipeline alignments. Sloped excavations may not be feasible in locations adjacent to existing utilities (if any).

Where the side of the excavation is a vertical cut, it should be adequately supported by temporary shoring to protect workers and any adjacent structures.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act, current amendments, and the Construction Safety Act should be met. The soil exposed in cuts should be observed during excavation by the owner's representative and the competent person employed by the contractor in accordance with regulations. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

11.2 Temporary Sloped Excavations

Temporary open-cut trenches may be constructed in areas not adjacent to existing underground utilities improvements with side slopes as recommended in the table below. Temporary cuts encountering soft and wet fine-grained soils, dry loose, cohesionless soils, or loose fill from trench backfill may have to be constructed at a flatter gradient than presented below.

Table No. 12, Slope Ratios for Temporary Excavations

Soil Type	OSHA Soil Type	Depth of Cut (feet)	Recommended Maximum Slope (Horizontal: Vertical)[1]
Silty Sand with Gravel (SM), Silty Sand (SM), Clay (CL)	C	0-10	1.5:1
		10-20	2:1

[1] Slope ratio is assumed to be constant from top to toe of slope, with level adjacent ground.

For shallow excavations up to 4 feet bgs, slope can be vertical. For steeper temporary construction slopes or deeper excavations, or unstable soil encountered during the excavation, shoring or trench shields should be provided by the contractor as necessary to protect the workers in the excavation.

Surfaces exposed in sloped excavations should be kept moist but not saturated to retard raveling and sloughing during construction. Adequate provisions should be made to protect the slopes from erosion during periods of rainfall. Surcharge loads, including construction materials, should not be placed within 5 feet of the unsupported slope edge. Stockpiled soils with a height higher than 6 feet will require greater distance from trench edges.

11.3 Shoring Design

Temporary shoring will be required where open sloped excavations will not be feasible due to unstable soils or due to nearby existing structures or facilities. Temporary shoring may consist of conventional soldier piles and lagging or sheet piles or any piles selected by contractor. The shoring for the pipe excavations may be laterally supported by walers and cross bracing or may be cantilevered. Drilled excavations for soldier piles will require the use of drilling fluids to prevent caving and to maintain an opened hole for pile installation.

The active earth pressure behind any shoring depends primarily on the allowable movement, type of backfill materials, backfill slopes, wall inclination, surcharges, and any hydrostatic pressures.

The lateral earth pressures to be used in the design of shoring is presented in the following table.

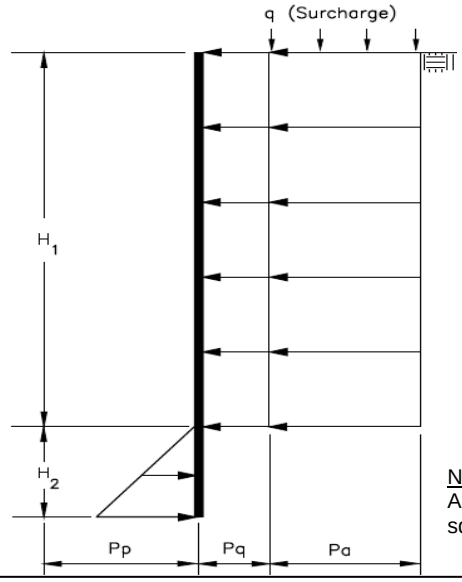
Table No. 13, Lateral Earth Pressures for Temporary Shoring

Lateral Resistance Soil Parameters*	Value
Active Earth Pressure (Braced Shoring) (psf) (A)	30
Active Earth Pressure (Cantilever Shoring) (psf) (B)	46
At-Rest Earth Pressure (Cantilever Shoring) (psf) (C)	68
Passive earth pressure (psf per foot of depth) (D)	250
Maximum allowable bearing pressure against native soils (psf) (E)	2,500
Coefficient of friction between sheet pile and native soils, fs (F)	0.25

* Parameters A through F are used in Figures No. 3 and 4 below.

Restrained (braced) shoring systems should be designed based on Figure No. 3, *Lateral Earth Pressures for Temporary Braced Excavation* to support a uniform rectangular lateral earth pressure.

Figure No. 3, Lateral Earth Pressures for Temporary Braced Excavation



Total Earth Pressure, P

P = Pq + Pa

Pq = 0.5q - incremental surcharge pressure

Pa = (A)H_1 - active earth pressure (Braced walls)

Lateral Pressure Resistance

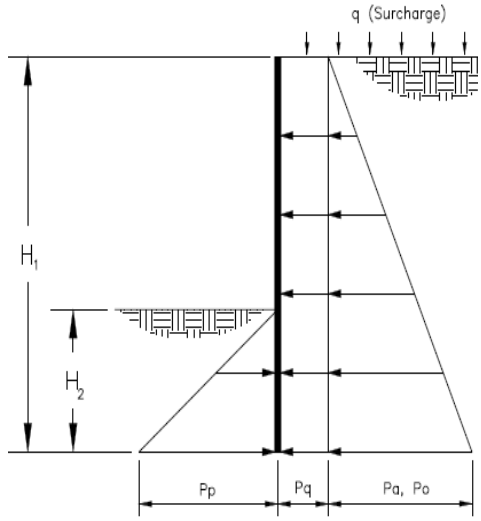
Pp = (D) H_2 ≤ (E) psf - passive earth pressure (on native soils)

μ = (F) - ultimate friction coefficient between steel sheet piles and soil

Note:
All values of height (H) in feet, pressure (P) and surcharge (q) in pounds per square foot (psf).

Unrestrained (cantilever) design of cantilever shoring consisting of soldier piles spaced at least two diameters on-center or sheet piles, can be based on Figure No. 4, *Lateral Earth Pressures on Temporary Cantilever Wall*.

Figure No. 4, Lateral Earth Pressures on Temporary Cantilever Wall



Total Earth Pressure, P

P = Pq + Pa, Po

Pq = 0.5q - incremental surcharge pressure

Pa = (B)H_1 - active earth pressure (Un-restrained)

Po = (C)H_1 - at rest earth pressure (Restrained)

Lateral Pressure Resistance

Pp = (D) H_2 ≤ (E) psf - passive earth pressure (on native soils)

μ = (F) - ultimate friction coefficient between steel sheet piles and soil

Note:
All values of height (H) in feet, pressure (P) and surcharge (q) in pounds per square foot (psf).

The provided pressures assume no hydrostatic pressures. If hydrostatic pressures are allowed to build up, the incremental earth pressures below the ground-water level should be reduced by 50 percent and added to hydrostatic pressure for total lateral pressure.

Passive resistance includes a safety factor of 1.5. The upper 1 foot for passive resistance should be ignored unless the surface is confined by a pavement or slab.

In addition to the lateral earth pressure, surcharge pressures due to miscellaneous loads, such as soil stockpiles, vehicular traffic or construction equipment located adjacent to the shoring, should be included in the design of the shoring. A uniform lateral pressure of 100 psf should be included in the upper 10 feet of the shoring to account for normal vehicular and construction traffic within 10 feet of the trench excavation. As previously mentioned, all shoring should be designed and installed in accordance with state and federal safety regulations.

The contractor should have provisions for soldier pile and sheet pile removal. All voids resulting from removal of shoring should be filled. The method for filling voids should be selected by the contractor, depending on construction conditions, void dimensions and available materials. The acceptable materials, in general, should be non-deleterious, and able to flow into the voids created by shoring removal (e.g., concrete slurry, “pea” gravel, etc.).

Excavations for the proposed pipeline should not extend below a 1:1 horizontal: vertical (H:V) plane extending from the bottom of any existing structures, utility lines or streets.

Any proposed excavation should not cause loss of bearing and/or lateral supports of the existing utilities or streets.

If the excavation extends below a 1:1 (H: V) plane extending from the bottom of the existing structures, utility lines or streets, a maximum of 10 feet of slope face parallel to the existing improvement should be exposed at a time to reduce the potential for instability. Backfill should be accomplished in the shortest period of time and in alternating sections.

12.0 CLOSURE

This report is prepared for the project described herein and is intended for use solely by WEBB, EMWD and their authorized agents, to assist in the design and construction of the proposed project. Our findings and recommendations were obtained in accordance with generally accepted professional principles practiced in geotechnical engineering. We make no other warranty, either expressed or implied.

Converse Consultants is not responsible or liable for any claims or damages associated with interpretation of available information provided to others. Field exploration identifies actual soil conditions only at those points where samples are taken, when they are taken. Data derived through sampling and laboratory testing is extrapolated by Converse employees who render an opinion about the overall soil conditions. Actual conditions in areas not sampled may differ. In the event that changes to the project occur, or additional, relevant information about the project is brought to our attention, the recommendations contained in this report may not be valid unless these changes and additional relevant information are reviewed, and the recommendations of this report are modified or verified in writing. In addition, the recommendations can only be finalized by observing actual subsurface conditions revealed during construction. Converse cannot be held responsible for misinterpretation or changes to our recommendations made by others during construction.

As the project evolves, continued consultation and construction monitoring by a qualified geotechnical consultant should be considered an extension of geotechnical investigation services performed to date. The geotechnical consultant should review plans and specifications to verify that the recommendations presented herein have been appropriately interpreted, and that the design assumptions used in this report are valid. Where significant design changes occur, Converse may be required to augment or modify the recommendations presented herein. Subsurface conditions may differ in some locations from those encountered in the explorations, and may require additional analyses and, possibly, modified recommendations.

Design recommendations given in this report are based on the assumption that the recommendations contained in this report are implemented. Additional consultation may be prudent to interpret Converse's findings for contractors, or to possibly refine these recommendations based upon the review of the actual site conditions encountered during construction. If the scope of the project changes, if project completion is to be delayed, or if the report is to be used for another purpose, this office should be consulted.

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Appendix A

Field Exploration

APPENDIX A

FIELD EXPLORATION

Our field investigation included alignments reconnaissance and a subsurface exploration program consisting of drilling soil borings. During the alignment reconnaissance, the surface conditions were noted, and the borings were marked at locations reviewed and approved by Brad Sackett with WEBB. The approximate boring locations were established in the field with reference to existing streets and other visible features. The locations should be considered accurate only to the degree implied by the method used. Permit was obtained from the City of Murrieta prior to the drilling on Los Alamos Road and Ruth Ellen Way, no permit was required for the remaining borehole locations.

Fifteen exploratory borings (BH-01 through BH-15) were drilled on October 18 and October 19, 2022, along the pipeline alignments to investigate the subsurface conditions. BH-01 was terminated due to possible utility conflict, BH-04, and BH-05 were terminated due to large concentration of aggregate. The borings details are presented in the following table.

Table No. A-1, Summary of Boring Information

Boring No.	Location	Boring Depth (ft, bgs)		Groundwater Depth (ft, bgs)	Date Completed
		Proposed	Completed		
BH-01	Los Alamos Road[t]	10.0	5.0**	N/E	10/19/2022
BH-02	Ruth Ellen Way[t]	10.0	11.5	N/E	10/19/2022
BH-03	Celia Road	10.0	11.4	N/E	10/18/2021
BH-04	Celia Road	10.0	6.0*	N/E	10/18/2021
BH-05	Celia Road	10.0	6.5*	N/E	10/18/2021
BH-06	Mary Place	10.0	10.3	N/E	10/18/2021
BH-07	Mary Place	10.0	10.3	N/E	10/18/2021
BH-08	Mary Place	10.0	10.6	N/E	10/18/2021
BH-09	Mary Place	10.0	11.5	N/E	10/18/2021
BH-10	Mason Avenue[v]	10.0	10.5	N/E	10/18/2021
BH-11	Mason Avenue[v]	10.0	10.9	N/E	10/18/2021
BH-12	Los Alamos Road[t]	10.0	10.3	N/E	10/19/2022
BH-13	Los Alamos Road[t]	10.0	11.3	N/E	10/19/2022
BH-14	Los Alamos Road[t]	10.0	10.4	N/E	10/19/2022

Boring No.	Location	Boring Depth (ft, bgs)		Groundwater Depth (ft, bgs)	Date Completed
		Proposed	Completed		
BH-15	Los Alamos Road[t]	10.0	10.2	N/E	10/19/2022

Note: - NE = not encountered.
* Refusal due to large concentration of aggregate.
**Refusal due to potential utility conflict
t=pavement cored, and core replaced with Pro Select Anchoring Adhesive and dyed black to match road surface.
v= pavement drilled directly into and patched with cold patch asphalt concrete.

The boring locations on Los Alamos Road and Ruth Ellen Way (BH-01, BH-02 and BH-12 through BH-15) were cored with coring machine, the remainder of the locations were not cored. Borings were then drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Encountered materials were continuously logged by a Converse geologist and classified in the field by visual classification in accordance with the Unified Soil Classification System. Where appropriate, the field descriptions and classifications have been modified to reflect laboratory test results.

Relatively undisturbed samples were obtained using California Modified Samplers (2.4 inches inside diameter and 3.0 inches outside diameter) lined with thin sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 140-pound driving weight falling 30 inches. Blow counts at each sample interval are presented on the boring logs. Samples were retained in brass rings (2.4 inches inside diameter and 1.0 inch in height) and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Bulk samples of typical soil types were also obtained.

Following the completion of logging and sampling, the borings were backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using the drill rig weight.

Borings (BH-03 through BH-09) were backfilled with soil cuttings and compacted by pushing down with an auger using drill rig weight due to the borings being located on dirt road. The surface of the borings that penetrated Los Alamos Road and Ruth Ellen Way (BH-01, BH-02 and BH-12 through BH-15), were patched with cored asphalt concrete piece and glued into place with Pro Select Anchoring Adhesive and dyed black. The borings that penetrated Mason Avenue (BH-10 and BH-11), were patched with cold patch asphalt.

If construction is delayed, the surface may settle over time. We recommend the owner monitor the boring locations and backfill any depressions that might occur or provide protection around the boring locations to prevent trip and fall injuries from occurring near the area of any potential settlement.

For a key to soil symbols and terminology used in the boring logs, refer to Drawing No. A-1a through A-1c, *Unified Soil Classification and Key to Boring Log Symbols*. For logs of borings, see Drawing Nos. A-2 through A-16, *Logs of Borings*.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 4546)
CP	Compaction Curve (ASTM D 1557)
CR	Corrosion, Sulfates, Chlorides (CTM 643-99; 417; 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeablility (ASTM D 2434)
PA	Particle Size Analysis (ASTM D 6913 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
SE	Sand Equivalent (ASTM D 2419)
SG	Specific Gravity (ASTM D 854)
SW	Swell Potential (ASTM D 4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166)
	Unconfined Compression - Rock (ASTM D 7012)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850) Unit
UW	Weight (ASTM D 2937)

BORING LOG SYMBOLS

SAMPLE TYPE

- STANDARD PENETRATION TEST — Split barrel sampler in accordance with ASTM D-1586-84 Standard Test Method
- DRIVE SAMPLE 2.42" I.D. sampler (CMS).
- DRIVE SAMPLE No recovery
- BULK SAMPLE
- GROUNDWATER WHILE DRILLING
- GROUNDWATER AFTER DRILLING

Dist. **Disturbed**

DRILLING METHOD SYMBOLS

Auger Drilling | Mud Rotary Drilling | Dynamic Cone or Hand Driven | Diamond Core

UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Project Name: EMWD Los Alamos Hills Pipeline
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing **A-1a**

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	SPT Blow Counts	Pocket Penetrometer (tsf)	CA Sampler	Torvane (tsf)	Field Approximation
Very Soft	<0.25	< 2	<0.25	<3	<0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	2 - 4	0.25 - 0.50	3 - 6	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	5 - 8	0.50 - 1.0	7 - 12	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	9 - 15	1.0 - 2.0	13 - 25	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	16 - 30	2.0 - 4.0	26 - 50	1.0 - 2.0	Readily indented by thumbnail
Hard	>4.0	>30	>4.0	>50	>2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60}- Value (blows / foot)	CA Sampler
Very Loose	<4	<5
Loose	4- 10	5 - 12
Medium Dense	11 - 30	13 - 35
Dense	31 - 50	36 - 60
Very Dense	>50	>60

MOISTURE

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OF PROPORTION OF SOILS

Descriptor	Criteria
Trace (fine)/ Scattered (coarse)	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION/ Induration

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptions and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Project Name: EMWD Los Alamos Hills Pipeline
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-223-02**

Drawing No. **A-1b**

LEGEND OF ROCK MATERIALS


IGNEOUS ROCK


SEDIMENTARY ROCK


METAMORPHIC ROCK

BEDDING SPACING

Description	Thickness/Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft - 10 ft
Thickly Bedded	1 ft - 3 ft
Moderately Bedded	4 in - 1 ft
Thinly Bedded	1 in - 4 in
Very Thinly Bedded	1/4 in - 1 in
Laminated	Less than 1/4 in

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Leaching		
Description	Body of Rock	Fracture Surfaces		Texture	Leaching	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No leaching	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, grain boundary conditions	All fracture surfaces are discolored or oxidized; surfaces friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

PERCENT CORE RECOVERY (REC)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)

$$\frac{\Sigma \text{ Length of intact core pieces} \geq 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

RQD* indicates soundness criteria not met.

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows
Very Hard	Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

Fracturing Spacing

Description	Observed Fracture Density
Unfractured	No fractures
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 to 3 ft.
Moderately Fractured	Core lengths mostly 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

REFERENCE Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

BEDROCK CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Project Name: EMWD Los Alamos Hills Pipeline
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. A-1c

Log of Boring No. BH-01-Los Alamos Road

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1274 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		6" CEMENT CONCRETE/ 4" AGGREGATE BASE						SE
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, moist, brown.			13/10/10	5	117	
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, few to little gravel up to 3.0 inches maximum dimension, medium dense, moist, yellowish brown.						
		End of boring at 5.0' feet bgs refusal due to potential conflict with utility. Groundwater not encountered. Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight,. Pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-2

Log of Boring No. BH-02-Ruth Ellen Way

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1290 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		4" CEMENT CONCRETE/ 9" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 0.8 inches maximum dimension. trace clay, dense, moist, brown.	■	▨	14/20/33	9	132	PA
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 2.0 inches maximum dimension. trace clay, dense, moist, gray.	■		14/18/25	10	127	
		-@7.5': few to little gravel up to 2 inches maximum dimension, very dense.	■		50-5"	11	103	
10		Scattered to few gravel up to 1 inch maximum dimension -@10.0': scattered to few gravel up to 1 inch maximum dimension, brown.	■		18/20/43	9	113	
		End of boring at 11.5' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight. Pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-3

Log of Boring No. BH-03-Celia Road

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1287 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.	■		3/12/17	6	118	
		ALLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, medium dense, moist, dark brown.	■	▨	6/15/20	23	107	DS
5		-@7.5': few clay, pinhole porosity.	■	▨	6/14/19	8	126	CR, CP
10		-@10.0': very dense.	■		17/46/50-4"	2	102	*disturbed
		End of boring at 11.4' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-4

Log of Boring No. BH-04-Celia Road

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1311 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **GRAVELY SAND WITH SILT (SP):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.	■		4/7/6	8	118	PA
5		**ALLUVIUM** **GRAVELY SAND WITH SILT (SP):** fine to coarse-grained, scattered to few gravel up to 3 inches maximum dimension, trace clay, very desiccated, medium dense, moist, brown.	■		18/22/43	22	90	
		CLAY WITH GRAVEL (CL): hard, moist, dark brown. -@6.0': yellowish brown.						
10		End of boring at 6.0' feet bgs due to refusal due to large concentration of aggregate. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-5

Log of Boring No. BH-05-Celia Road

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1332 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.						CR
			■		8/14/34	7	127	
		ALLUVIUM **SILTY SAND (SM):** fine to medium-grained, trace clay, pinhole porosity, dense, moist, dark brown.						
5		-@5.0': very dense.	■		13/17/50-3"	9	126	DS
		End of boring at 6.5' feet bgs due to refusal due to large concentration of aggregate. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-6

Log of Boring No. BH-06-Mary Place

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1356 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.	■		13/14/26	5	123	
		ALLUVIUM **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 1 inch in maximum dimension, trace clay, dense, dry, brownish red.	■		23/50-3"	4	110	PA
5		-@5.0': very dense, roots, yellowish brown.			50-3"	2	99	*disturbed
10		-@10.0': grayish brown.	■		50-3"	2	112	*disturbed
		End of boring at 10.3' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-7

Log of Boring No. BH-07-Mary Place

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1341 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.						SE, CP
			■		12/10/12	6	114	
		ALLUVIUM **SILTY SAND (SM):** fine to medium-grained, trace clay, medium dense, dry, reddish-brown.						
5		-@5.0': very dense.	■		11/33/50	1	130	DS
		-@7.5': yellowish brown.			50-3"	3	108	*disturbed
10					50-4"	3	68	*disturbed
		End of boring at 10.3' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-8

Log of Boring No. BH-08-Mary Place

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1353 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches in maximum dimension, scattered cobbles up to 8 inches in maximum dimension, brown.	■		8/44/50-3"	3	138	
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 0.5 inches in maximum dimension, very dense, dry, yellowish brown.	■	▨	40/50-4"	5	115	CR, PA
		-@7.5": grayish brown.	■	▨	50-4"	2	120	*disturbed
10			■	▨	48/50-1"	3	69	*disturbed
		End of boring at 10.6' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-9

Log of Boring No. BH-09-Mary Place

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1375 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 3 inches maximum dimension, scattered cobbles up to 8 inches maximum dimension, brown.	■	▨	6/27/29	6	125	
		ALLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, dense, moist, dark brown.						
5		-@5.0': very desiccated, dry.	■		14/18/22	6	119	DS
		-@7.5': pinhole porosity, moist.	■		14/22/30	7	127	
10			■		16/20/22	12	114	
		End of boring at 11.5' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings and compacted with weight of drill rig on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-10

Log of Boring No. BH-10-Mason Avenue

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1381 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		4" CEMENT CONCRETE/ 3" AGGREGATE BASE						
		ALLUVIUM						
		SILTY SAND (SM): fine to coarse-grained, trace clay, medium dense, moist, yellowish brown.	■		11/13/19	7	128	
5		-@5.0': very dense.	■	▨	50-6"	11	113	SE
			■	▨	50-4"	6	107	
10		**SAND (SP):** fine to coarse-grained, trace clay, very dense, moist, yellowish brown.	■	▨	50-6"	5	114	
		End of boring at 10.5' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings, compacted using the weight of the drill rig and patched with cold patch on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-11

Log of Boring No. BH-11-Mason Avenue

Date Drilled: 10/18/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1375 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		2" CEMENT CONCRETE/ 4" AGGREGATE BASE						CR
		ALLUVIUM						
		SILTY SAND (SM): fine to coarse-grained, trace clay, medium dense, moist, dark brown.	■	▨	8/9/12	5	123	
5		-@5.0': pinhole porosity.	■		10/11/4	5	115	
		-@7.5': dense.	■		10/17/28	8	117	DS
10		-@10.0': brownish gray, very dense.	■		26/50-5"	5	127	
		End of boring at 10.9' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings, compacted using the weight of the drill rig and patched with cold patch on 10/18/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-12

Log of Boring No. BH-12-Los Alamos Road

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1374 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		5" CEMENT CONCRETE/ 2" AGGREGATE BASE						SE, PA
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 0.5 inches in maximum dimension, trace clay, pinhole porosity, very dense, moist, brown.	■	▨	7/32/35	4	127	
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 0.5 inches in maximum dimension, trace clay, pinhole porosity, medium dense, moist, brown.	■		5/6/7	4	110	
		-@7.5': caliche.	■		8/10/13	3	115	
10		-@10.0': fragments of rock.	■		50-4"	3	117	*disturbed
		End of boring at 10.3' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight. Pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-13

Log of Boring No. BH-13-Los Alamos Road

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1351 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		5" CEMENT CONCRETE/ 4" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 1 inch maximum dimension, trace clay, medium dense, moist, light brown.	■		13/24/18	5	127	
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, dense, moist, brown. -@5.0': very dense.	■	▨	12/24/38	7	128	DS CP
		-@7.5': very dense.	■	▨	15/24/50-6"	9	117	
10		-@10.0': fragments of rockk.	■		13/42/50-3"	6	135	
		End of boring at 10.3' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight. Pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-14

Log of Boring No. BH-14-Los Alamos Road

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1344 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		5" CEMENT CONCRETE/ 4" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, very dense, moist, reddish-brown.	■	▨	14/43/50-5"	4	134	PA
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, very dense, moist, yellowish brown.	■		24/34/50-4"	10	114	
					50-4"	9	94	
10			■		50-5"	3	101	*disturbed
		End of boring at 10.4' feet bgs. Groundwater not encountered. Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight, pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.						

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. 22-81-144-02

Drawing No. A-15

Log of Boring No. BH-15-Los Alamos Road

Date Drilled: 10/19/2022 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1321 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the Boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		5" CEMENT CONCRETE/ 2" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, very desiccated, very dense, moist, brown.	■		21/50-4"	5	123	
5		**ALLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, moderately to very desiccated, very dense, moist, gray.	■		24/50-3"	7	113	
		BEDROCK **Undifferentiated Gabbro with Hornblende** **EXCAVATES AS SILTY SAND (SM):** fine to coarse-grained, very desiccated, very dense, moist, gray.	■		50-4"	10	94	
10					50-2"			

End of boring at 10.2' feet bgs.
Groundwater not encountered.
Borehole backfilled with soil cuttings mixed with cement and compacted by pushing down with an auger using drill rig weight. Pavement patched with cut core and glued into place with Pro Select Anchoring Adhesive dyed black on 10/19/2022.

Appendix B

Laboratory Testing Program

APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our laboratory on representative soil samples for the purpose of classification and evaluation of their physical properties and engineering characteristics. The amount and selection of tests were based on the geotechnical parameters required for this project. Test results are presented herein and on the Logs of Borings, in Appendix A, *Field Exploration*. The following is a summary of the various laboratory tests conducted for this project.

***In-Situ* Moisture Content and Dry Density**

In-situ dry density and moisture content tests were performed on relatively undisturbed ring samples, in accordance with ASTM Standard D2216 and D2937 to aid soils classification and to provide qualitative information on strength and compressibility characteristics of the alignment's soils. For test results, see the Logs of Boring in Appendix A*, Field Exploration*.

Sand Equivalent

Four representative soil samples were tested in accordance with the ASTM Standard D2419 test method to determine the sand equivalent. The test results are presented in the following table.

Table No. B-1, Sand Equivalent Test Results

Boring No.	Street	Depth (feet)	Soil Description	Sand Equivalent
BH-01	Los Alamos Road	0.8 – 5.0	Silty Sand (SM)	34
BH-07	Mary Place	0.8 – 5.0	Silty Sand (SM)	23
BH-10	Mason Avenue	5.0 – 10.0	Silty Sand (SM)	29
BH-12	Los Alamos Road	0.6 – 5.0	Silty Sand (SM)	21

Soil Corrosivity

Four representative soil samples were tested to determine minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The purpose of these tests was to determine the corrosion potential of soils when placed in contact with common construction materials. These tests were performed by AP Engineering and Testing, Inc. (Pomona, CA) in accordance with Caltrans Test Methods 643, 422 and 417. Test results are presented in the following table.

Table No. B-2, Summary of Soil Corrosivity Test Results

Boring No.	Street	Depth (feet)	pH	Soluble Sulfates (CA 417) (ppm)	Soluble Chlorides (CA 422) (ppm)	Min. Resistivity (CA 643) (Ohm-cm)
BH-03	Celia Way at Celia Way	5.0-10.0	7.6	35	26	2,107
BH-05	Celia Way at Mary Place	1.0 – 5.0	7.4	38	27	2,208
BH-08	Mary Place.	5.0 – 10.0	7.4	16	19	10,248
BH-11	Mason Avenue	0.5 – 5.0	7.3	35	24	2,045

Grain-Size Analyses

To assist in classification of soils, mechanical grain-size analyses were performed on six select samples in accordance with the ASTM Standard D6913 test method. Grain-size curves are shown in Drawing Nos. B-1a and B-1b, *Grain Size Distribution Results* and results are presented in the below table.

Table No. B-3, Grain Size Distribution Test Results

Boring No.	Street	Depth (ft)	Soil Classification	% Gravel	% Sand	%Silt	%Clay
BH-02	Ruth Ellen Way	1.1-5.0	Silty Sand (SM)	10.0	67.7	22.3	
BH-04	Celia Road	1.0–6.0	Gravely Sand with Silt (SP)	33.0	38.5	28.5	
BH-06	Mary Place	5.0–10.0	Silty Sand (SM)	0.0	83.6	16.4	
BH-08	Mary Place	5.0–10.0	Silty Sand (SM)	2.0	79.2	18.8	
BH-12	Los Alamos Road	0.6-5.0	Silty Sand (SM)	7.0	60.6	32.4	
BH-14	Los Alamos Road	0.8-5.0	Silty Sand (SM)	6.0	63.6	30.4	

Maximum Density and Optimum Moisture Content

Laboratory maximum dry density-optimum moisture content relationship tests were performed on three representative bulk samples. The tests were conducted in accordance with the ASTM Standard D1557 test method. The test results are presented in Drawing Nos. B-2a and B-2b, *Moisture-Density Relationship Results,* and are summarized in the following table.

Table No B-4, Summary of Moisture-Density Relationship Results

Boring No.	Boring No./ Street	Depth (feet)	Soil Description	Optimum Moisture (%)	Maximum Density (lb/cft)
BH-03	Celia Road	5.0-10.0	Silty Sand (SM), Dark Brown	4.4	136.0
BH-07	Mary Place	0.8-5.0	Silty Sand (SM), Dark Brown	7.2	135.0
BH-13	Los Alamos Road	5.0-10.0	Silty Sand (SM), Brown	4.8	131.0

Direct Shear

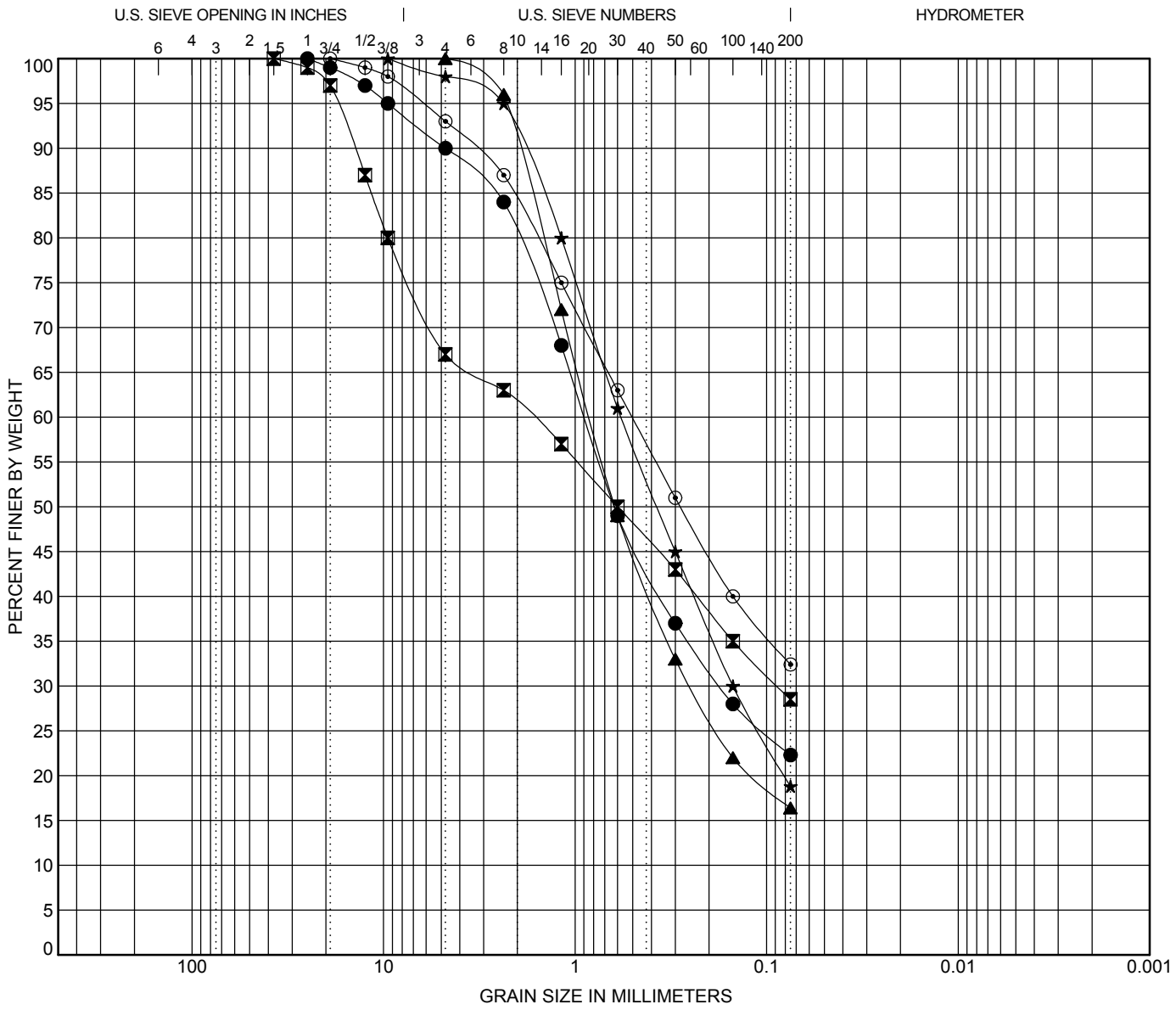
Six direct shear tests were performed on relatively undisturbed samples under soaked condition in accordance with ASTM Standard 3080. For each test, 3 samples contained in a brass sampler ring were placed, one at a time, directly into the test apparatus and subjected to a range of normal loads appropriate for the anticipated conditions. The samples were then sheared at a constant strain rate of 0.02 inch/minute. Shear deformation was recorded until a maximum of about 0.25-inch shear displacement was achieved. Ultimate strength was selected from the shear-stress deformation data and plotted to determine the shear strength parameters. For test results, including sample density and moisture content, see Drawing Nos. B-3 through B-08*, Direct Shear Test Results,* and in the following table.

Table No. B-5, Summary of Direct Shear Test Results

Boring No.	Boring No./ Street	Depth (feet)	Soil Description	Peak Strength Parameters	
				Friction Angle (degrees)	Cohesion (psf)
BH-03	Celia Road	5.0-6.5	Silty Sand (SM)	31	380
BH-05	Celia Road and Mary Place	5.0-6.3	Silty Sand (SM)	41	110
BH-07	Los Alamos Road	5.0-6.5	Silty Sand (SM)	25	540
BH-09	Mary Place	5.0-6.5	Silty Sand (SM)	31	290
BH-11	Mason Avenue	7.5-9.0	Silty Sand (SM)	30	250
BH-13	Los Alamos Road	5.0-6.5	Silty Sand (SM)	36	200

Sample Storage

Soil samples presently stored in our laboratory will be discarded 30 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	BH-02-Ruth Ellen Way	1.1-5.0	SILTY SAND (SM)					
⊠	BH-04-Celia Road	1.0-6.0	GRAVELY SAND WITH SILT (SP)					
▲	BH-06-Mary Place	5.0-10.0	SILTY SAND (SM)					
★	BH-08-Mary Place	5-10	SILTY SAND (SM)					
⊙	BH-12-Los Alamos Road	0.6-5.0	SILTY SAND (SM)					

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-02-Ruth Ellen Way	1.1-5.0	25	0.888	0.175		10.0	67.7	22.3	
⊠	BH-04-Celia Road	1.0-6.0	37.5	1.669	0.088		33.0	38.5	28.5	
▲	BH-06-Mary Place	5.0-10.0	4.75	0.829	0.248		0.0	83.6	16.4	
★	BH-08-Mary Place	5-10	9.5	0.575	0.15		2.0	79.2	18.8	
⊙	BH-12-Los Alamos Road	0.6-5.0	19	0.505			7.0	60.6	32.4	

GRAIN SIZE DISTRIBUTION RESULTS

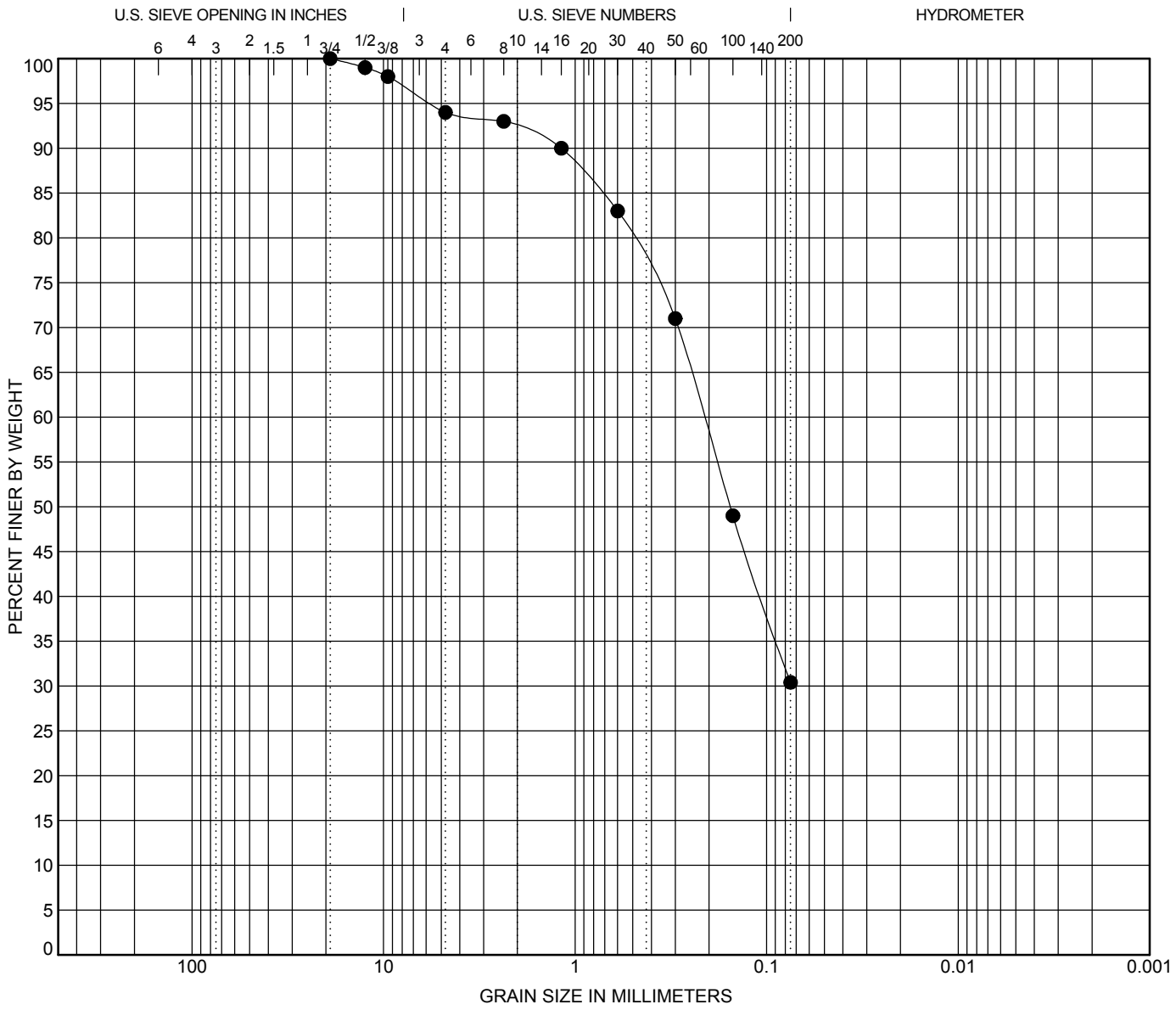
Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-1a**

Project ID: 22-81-144-02.GPJ; Template: GRAIN SIZE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	BH-14-Los Alamos Road	0.8-5.0	SILTY SAND (SM)					

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-14-Los Alamos Road	0.8-5.0	19	0.212			6.0	63.6	30.4	

GRAIN SIZE DISTRIBUTION RESULTS

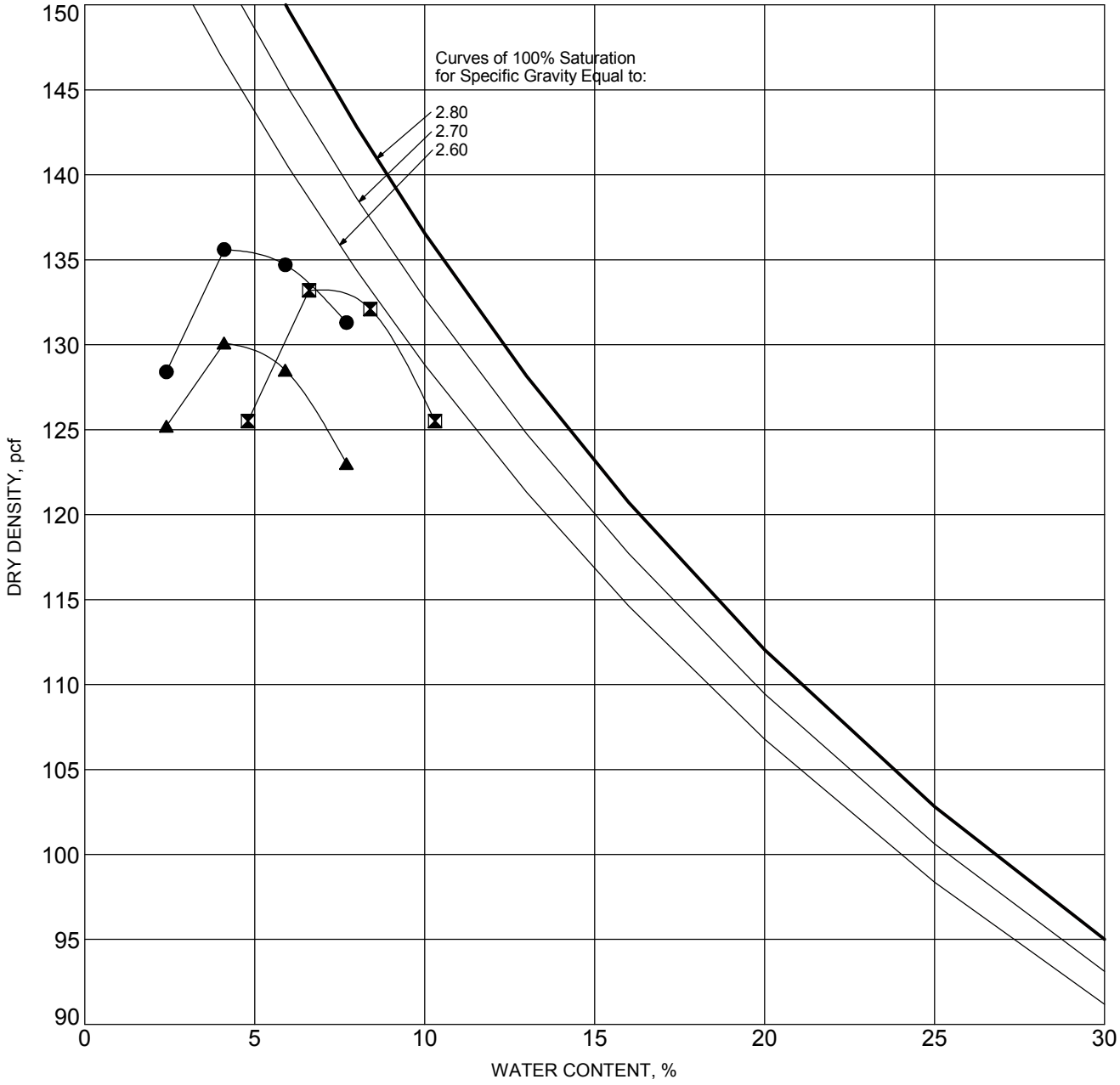
Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-1b**

Project ID: 22-81-144-02.GPJ; Template: GRAIN SIZE



SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	**BH-03-Celia Road**	**5.0-10.0**	**SILTY SAND (SM), DARK BROWN**	**D1557 A**	**4.4**	**136**
⊠	**BH-07-Mary Place**	**0-5.0**	**SILTY SAND (SM), REDDISH BROWN**	**D1557 A**	**7.2**	**135**
▲	**BH-13-Los Alamos Road**	**5.0-10.0**	**SILTY SAND (SM), BROWN**	**D1557 A**	**4.8**	**131**

MOISTURE-DENSITY RELATIONSHIP RESULTS

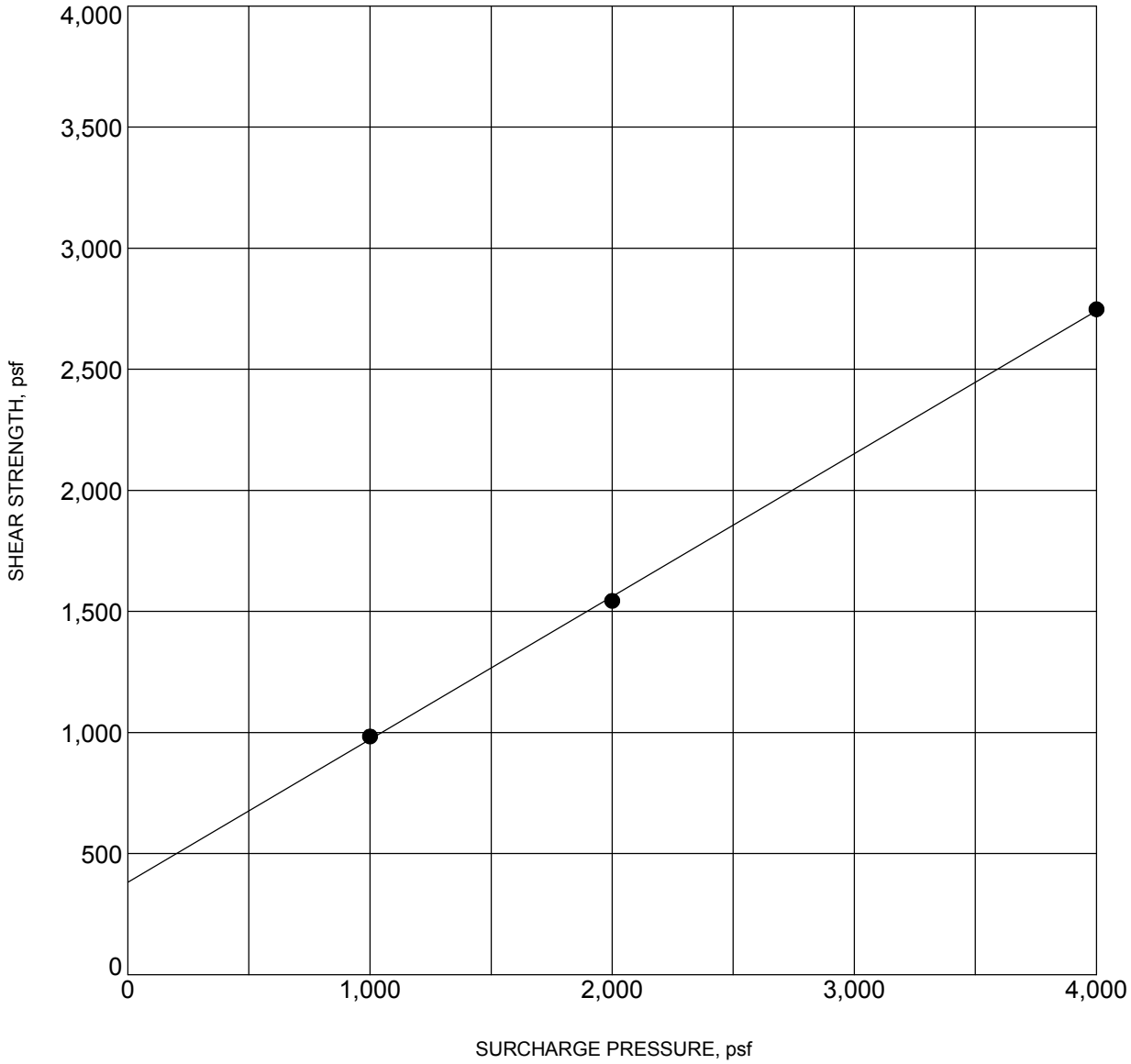
Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-2**

Project ID: 22-81-144-02.GPJ; Template: COMPACTION



BORING NO.	:	**BH-03-Celia Road**	DEPTH (ft)	:	**5.0-10.0**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**380**	FRICTION ANGLE (degrees):		**31**
MOISTURE CONTENT (%)	:	**23.0**	DRY DENSITY (pcf)	:	**107.0**

NOTE: Ultimate Strength.

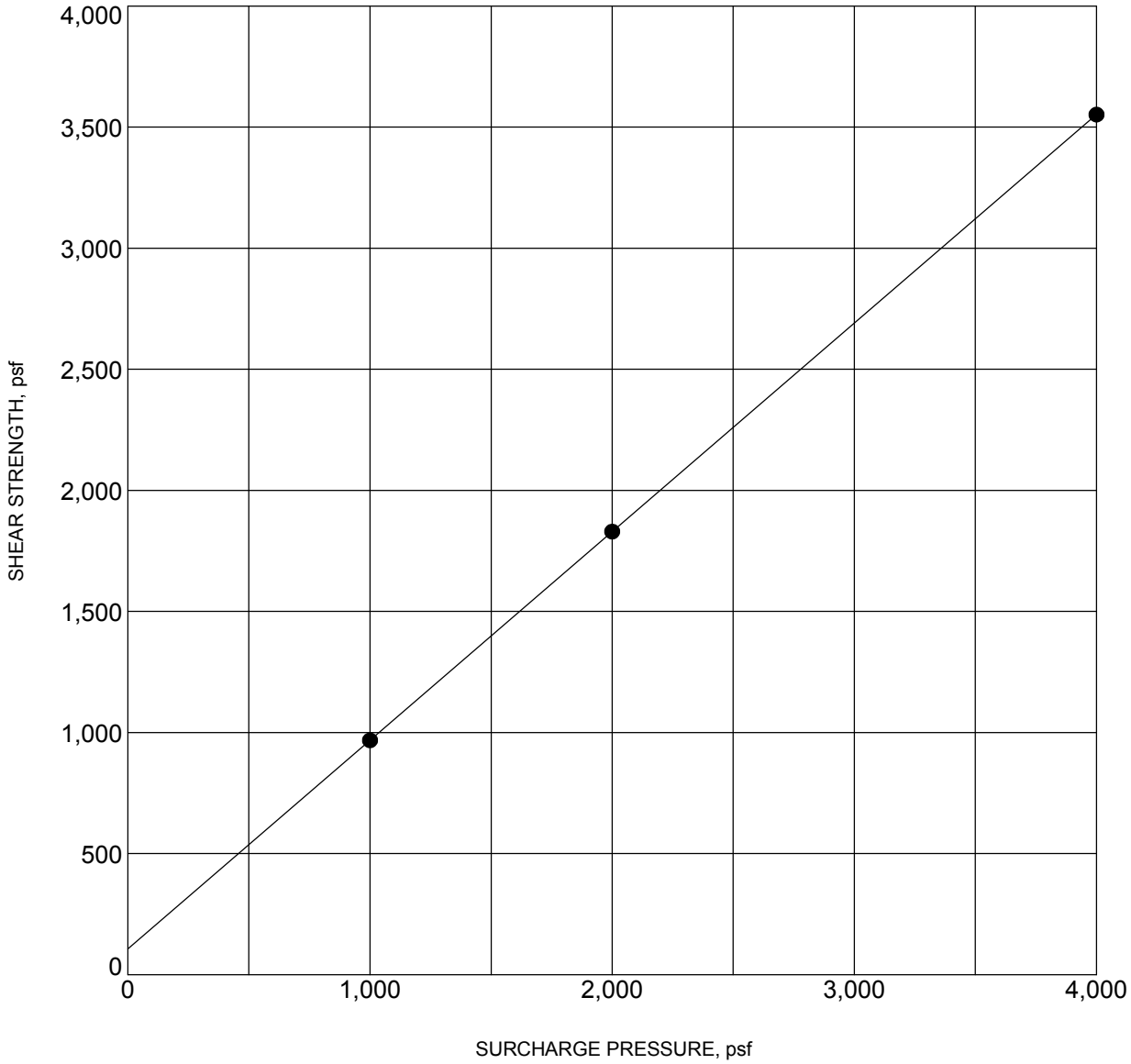
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-3**



BORING NO.	:	**BH-05-Celia Road**	DEPTH (ft)	:	**5.0-6.5**
DESCRIPTION	:	**SILTY SAND(SM)**			
COHESION (psf)	:	**110**	FRICTION ANGLE (degrees):		**41**
MOISTURE CONTENT (%)	:	**9.0**	DRY DENSITY (pcf)	:	**126.0**

NOTE: Ultimate Strength.

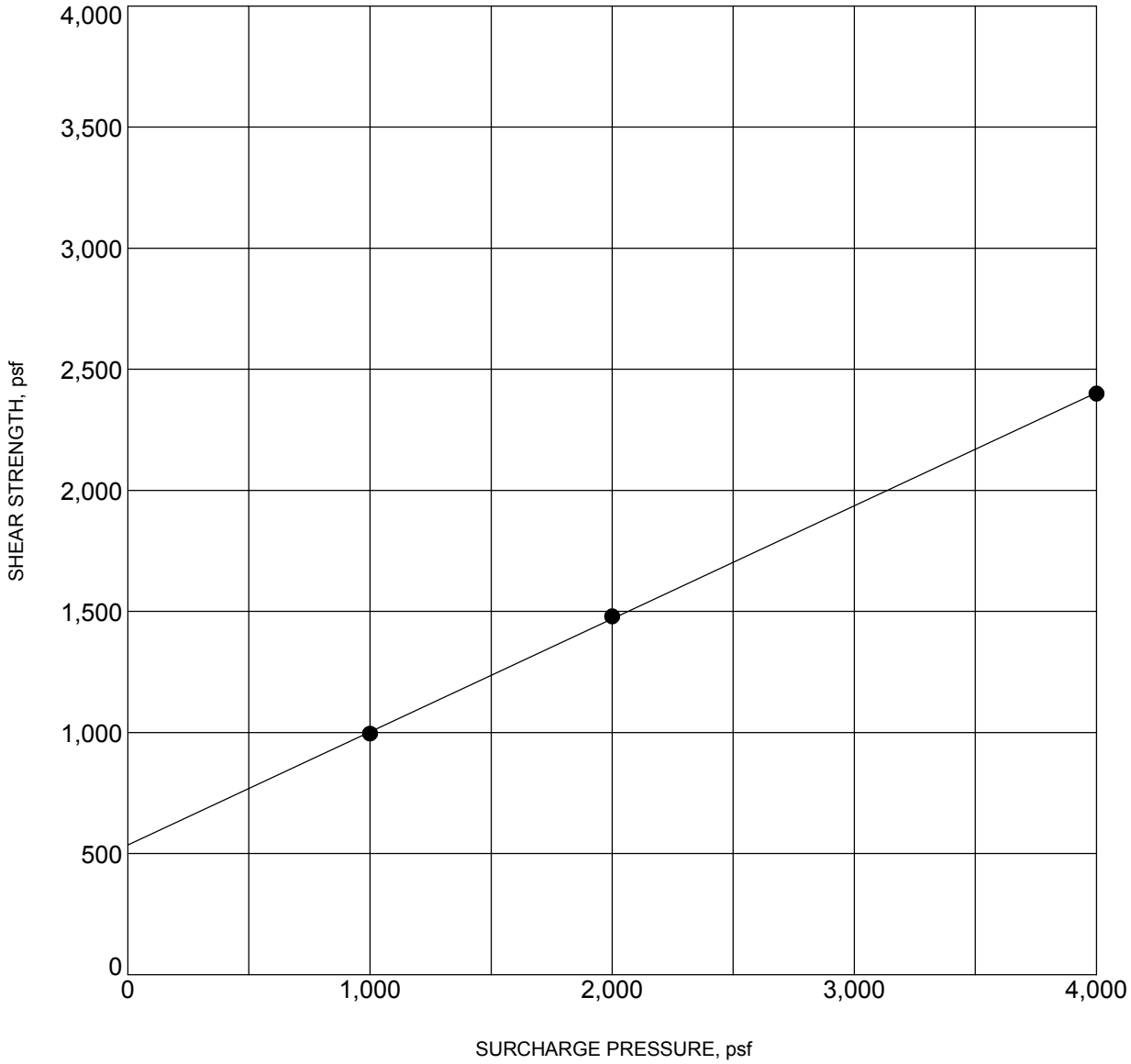
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-4**



BORING NO.	:	**BH-07-Mary Place**	DEPTH (ft)	:	**5.0-6.5**
DESCRIPTION	:	**SILTY SAND(SM)**			
COHESION (psf)	:	**540**	FRICTION ANGLE (degrees):		**25**
MOISTURE CONTENT (%)	:	**1.0**	DRY DENSITY (pcf)	:	**130.0**

NOTE: Ultimate Strength.

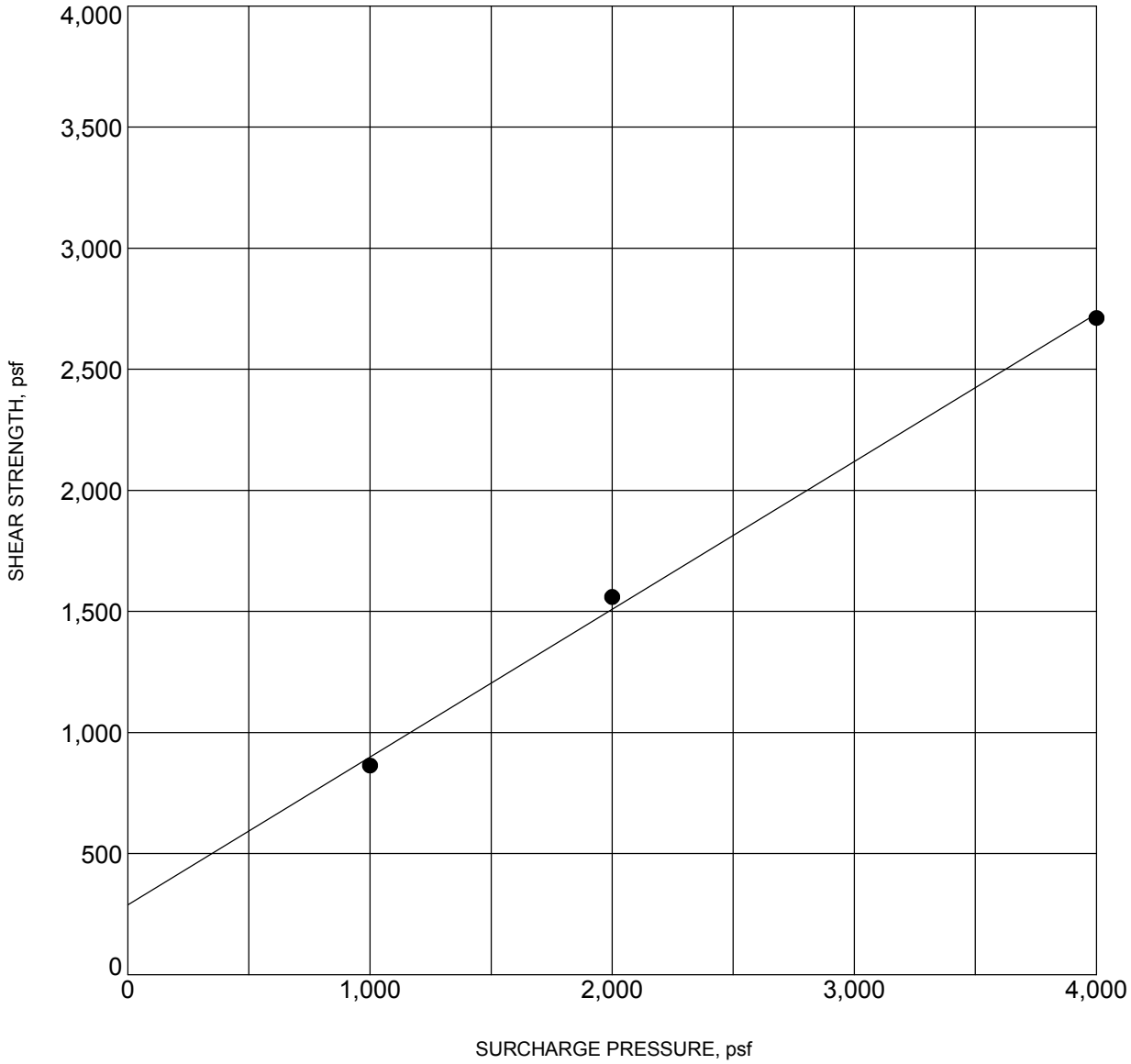
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-5**



BORING NO.	:	**BH-09-Mary Place**	DEPTH (ft)	:	**5.0-6.5**
DESCRIPTION	:	**SILTY SAND(SM)**			
COHESION (psf)	:	**290**	FRICTION ANGLE (degrees):		**31**
MOISTURE CONTENT (%)	:	**6.0**	DRY DENSITY (pcf)	:	**119.0**

NOTE: Ultimate Strength.

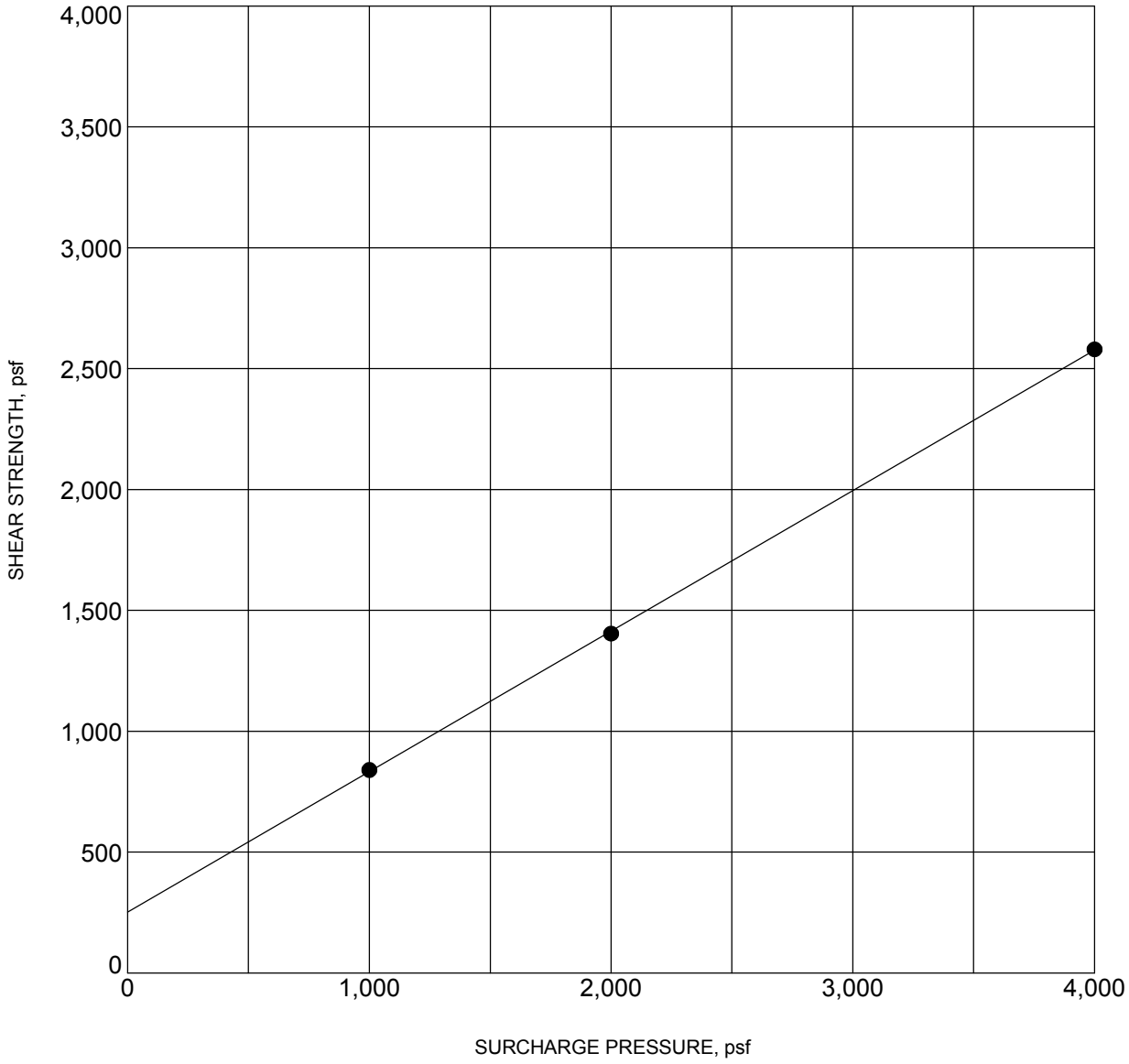
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-6**



BORING NO.	:	**BH-11-Mason Avenue**	DEPTH (ft)	:	**7.5-9.0**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**250**	FRICTION ANGLE (degrees):		**30**
MOISTURE CONTENT (%)	:	**8.0**	DRY DENSITY (pcf)	:	**117.0**

NOTE: Ultimate Strength.

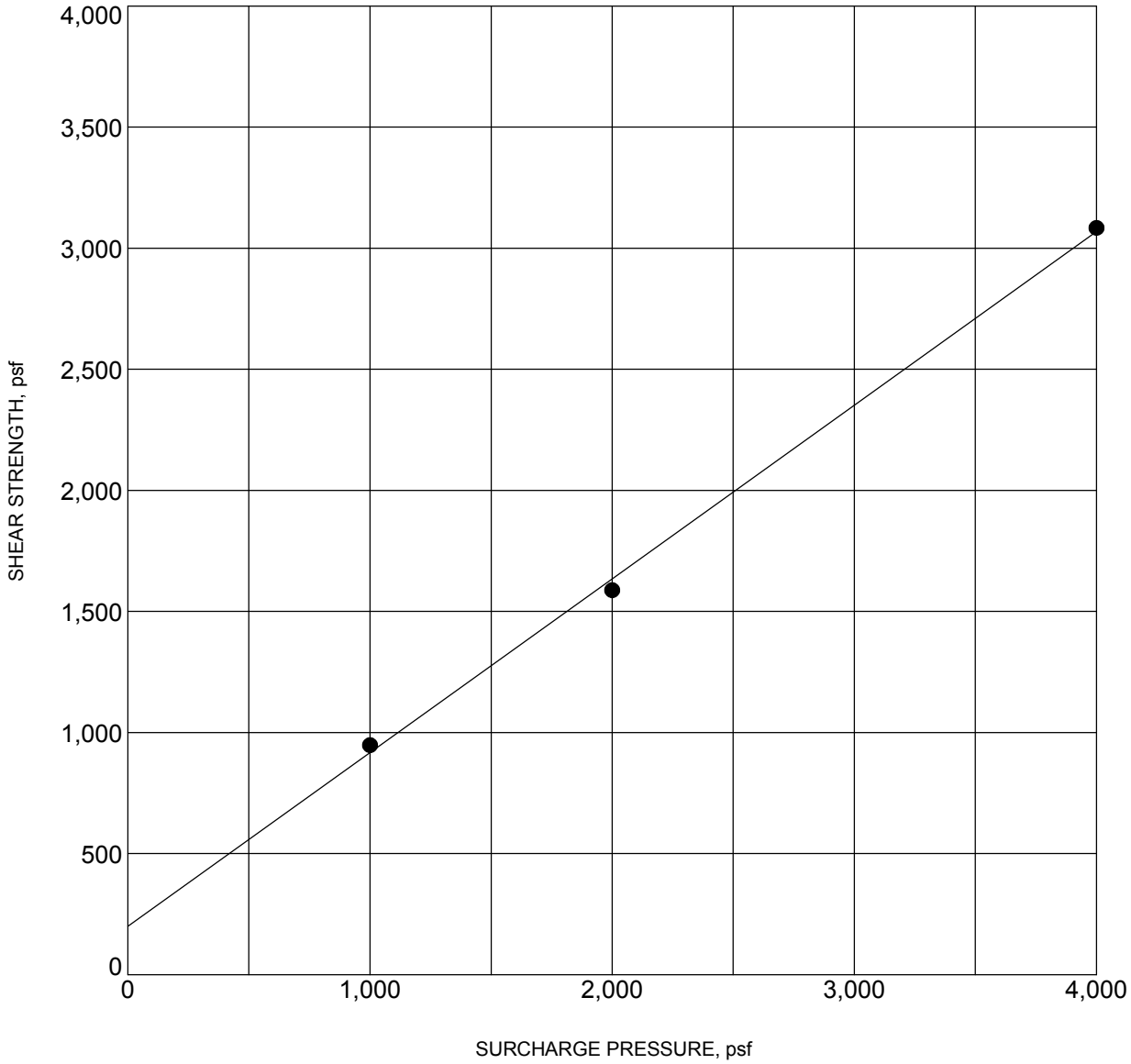
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-7**



BORING NO.	:	**BH-13-Los Alamos Road**	EPTH (ft)	:	**5.0-6.5**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**200**	FRICTION ANGLE (degrees):		**36**
MOISTURE CONTENT (%)	:	**7.0**	DRY DENSITY (pcf)	:	**128.0**

NOTE: Ultimate Strength.

DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name: EMWD Los Alamos Hills
Project Location: Los Alamos Road, Ruth Allen Way, Celia Road, Mary Place, and Mason Avenue
City of Murrieta, Riverside County, California
For: Webb Associates

Project No. **22-81-144-02**

Drawing No. **B-8**