Appendix E

Geotechnical Investigation Report

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

GEOTECHNICAL INVESTIGATION REPORT

HIGHWAY 86 WATER TRANSMISSION MAIN, PHASES 3 & 4

Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

CONVERSE PROJECT NO. 21-81-260-02

Prepared For:
ALBERT A. WEBB ASSOCIATES
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September 12, 2023

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

September 12, 2023

Mr. Shane Bloomfield, PE
Senior Engineer
Albert A. Webb Associates
3788 McCray Street
Riverside, CA 92506

Subject: **GEOTECHNICAL INVESTIGATION REPORT**
Highway 86 Water Transmission Main, Phases 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
Converse Project No. 21-81-260-02

Dear Mr. Bloomfield:

Converse Consultants (Converse) is pleased to submit this geotechnical investigation report to assist with the design and construction of Highway 86 Water Transmission Main, Phases 3 & 4 project, located in the Riverside and Imperial Counties, California. This report is prepared in accordance with our revised proposal dated October 20, 2021, and your Subconsultant Agreement for Professional Services dated January 17, 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 continued service to Albert A. Webb Associates (Webb), and Coachella Valley Water District (CVWD). Should have any questions, please contact the undersigned at 909-474-2847.

CONVERSE CONSULTANTS

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

Dist.: 1-Electronic-PDF/Addressee
HSQ/EH/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.

SK Syfur Rahman, PhD, EIT
Sr. Staff Engineer

Elizabeth Hernandez
Staff Geologist

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

TABLE OF CONTENTS

FIGURES

Following Page No.

TABLES

Page No.

APPENDICES

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation performed by Converse for the Highway 86 Water Transmission Main, Phases 3 & 4 project, located in the Riverside and Imperial Counties, California. The project location is shown in Figure No. 1a through 1g, *Approximate Alignment Location Maps.*

The purpose of this investigation was to evaluate the nature and engineering properties of the subsurface soils and groundwater conditions, and to provide geotechnical recommendations for the design and construction of the proposed pipeline.

This report was prepared for the project described herein and is intended for use solely by Albert A. Webb Associates, and Coachella Valley Water District (CVWD), and their authorized agents. This report may be made available to the prospective bidders for bidding purposes. However, the bidders are responsible for their own interpretation of the alignment conditions between and beyond the boring locations, based on factual data contained in this report. This report may not contain sufficient information for use by others and/or other purposes.

2.0 PROJECT DESCRIPTION

The project is intended to identify various opportunities and constraints in order to determine a preferred pipeline alignment that minimizes right-of-way acquisition, clearly identifies permit requirements, minimize potential tribal and environmental impacts, is cost-effective, and provides the necessary environmental approvals to secure state and federal funding.

According to the information provided by Albert A. Webb Associates, the Highway 86 Water Transmission, Phases 3 & 4 project, will require a preliminary engineering report, final plans, specifications, cost estimate and final design document. Phases 3 & 4 will replace approximately 13.4 miles of existing 16-inch and 18-inch diameter transmission mains.

The depth of pipe invert will be between 7.0-8.0 feet below existing ground surface (bgs). At existing structures crossings, the pipe will be installed using the bore and jack technique. It is anticipated that at 4 locations the pipe will be installed using the bore and jack technique.

The existing pipeline is currently within Caltrans right-of-way. We understand that Caltrans may not allow the new transmission main to be placed longitudinally within their right-of-way. In addition, the new pipeline alignment may cross tribal lands.

Project: Highway 86 Water Transmission Main, Phase 3 & 4

Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No.
21-81-260-02

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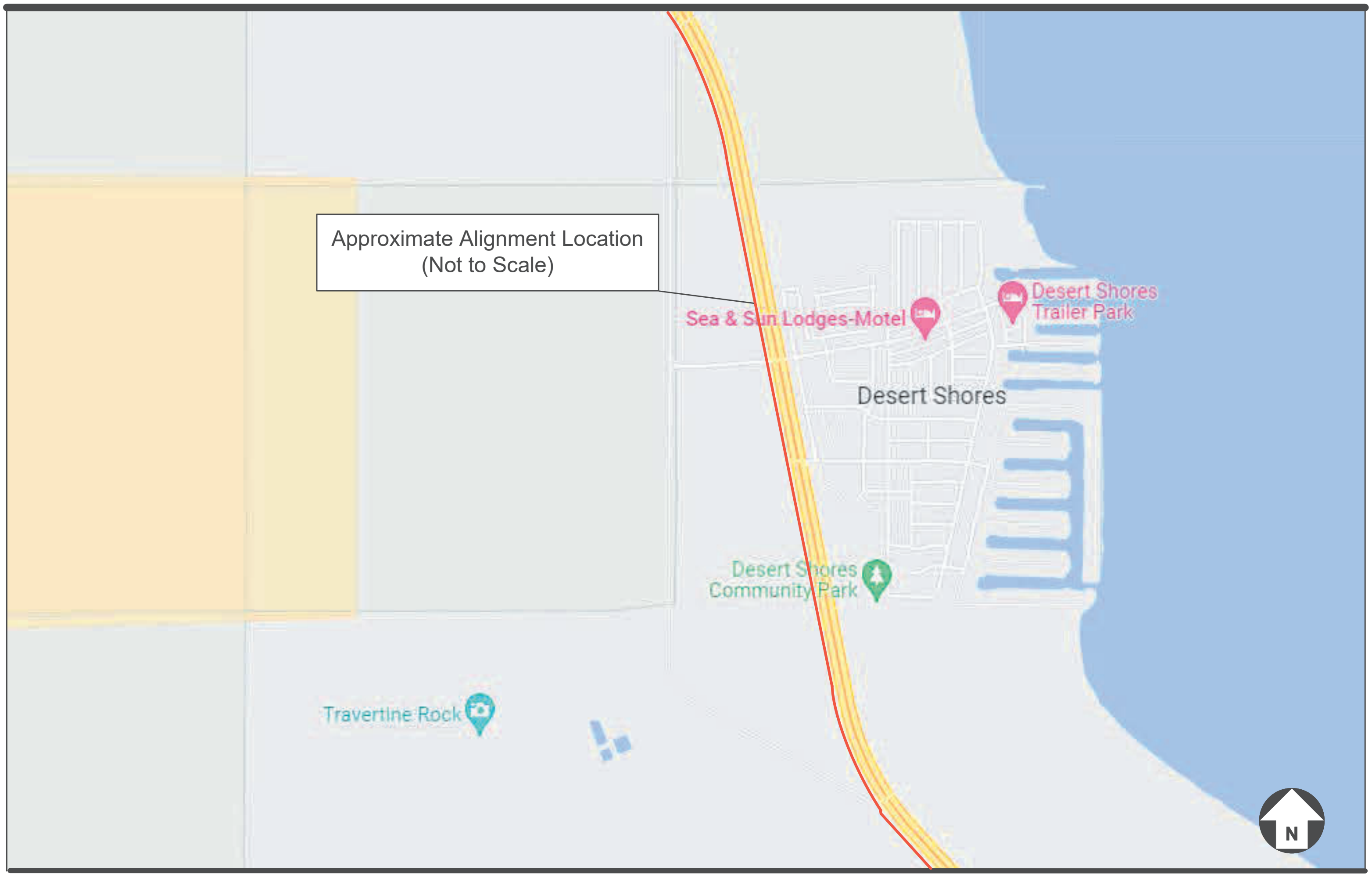
Figure No.
1a



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Approximate Alignment Location Map

Project No. 21-81-260-02

Converse Consultants

Figure No. 1b

Project: Highway 86 Water Transmission Main, Phase 3 & 4

Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No.
21-81-260-02

Converse Consultants

Figure No.
1c

Project: Highway 86 Water Transmission Main, Phase 3 & 4

Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

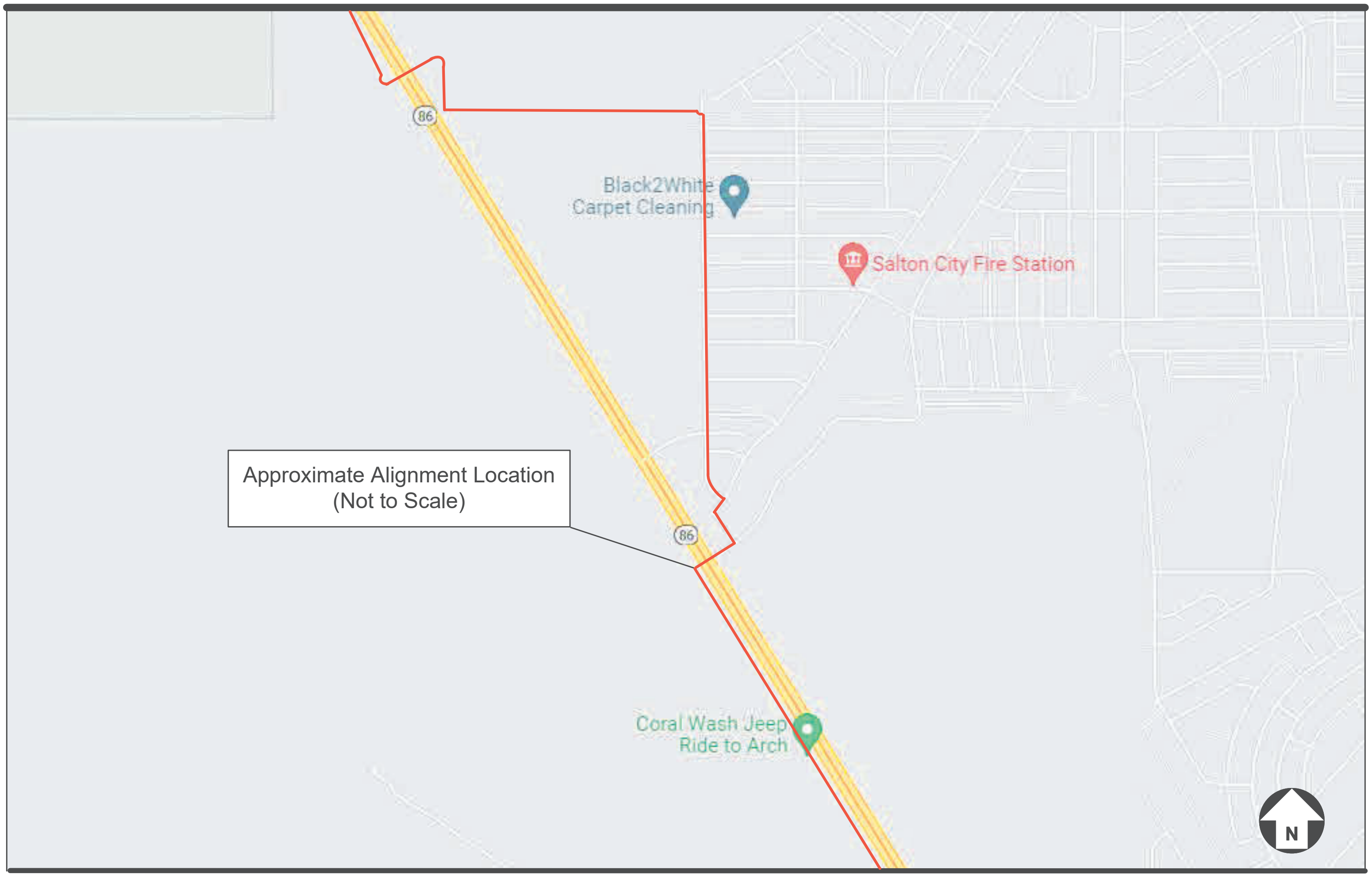
For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No.
21-81-260-02

Converse Consultants

Figure No.
1d



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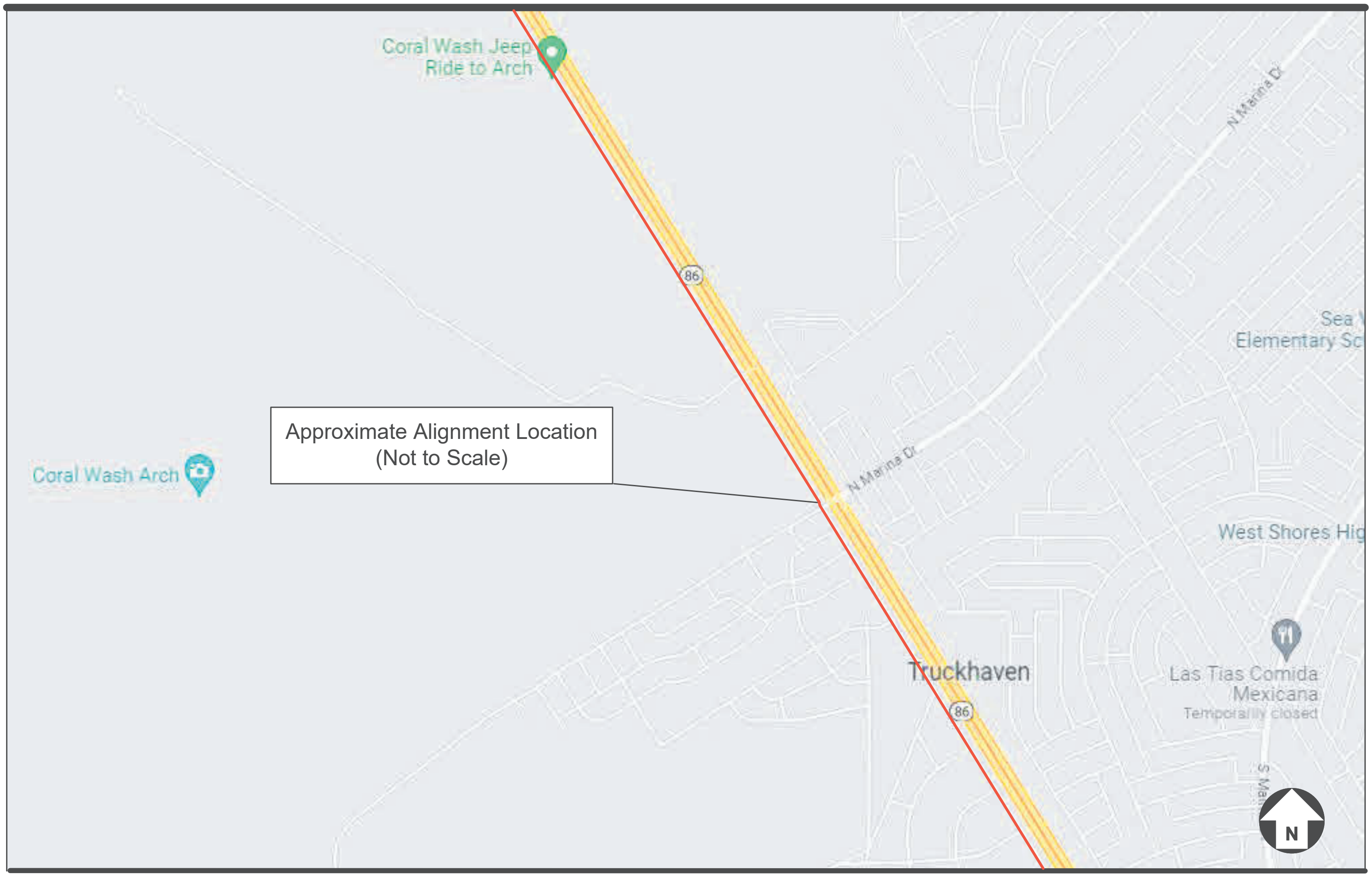
For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No. 21-81-260-02

Converse Consultants

Figure No. 1e



Project: Highway 86 Water Transmission Main, Phase 3 & 4
Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No.
21-81-260-02

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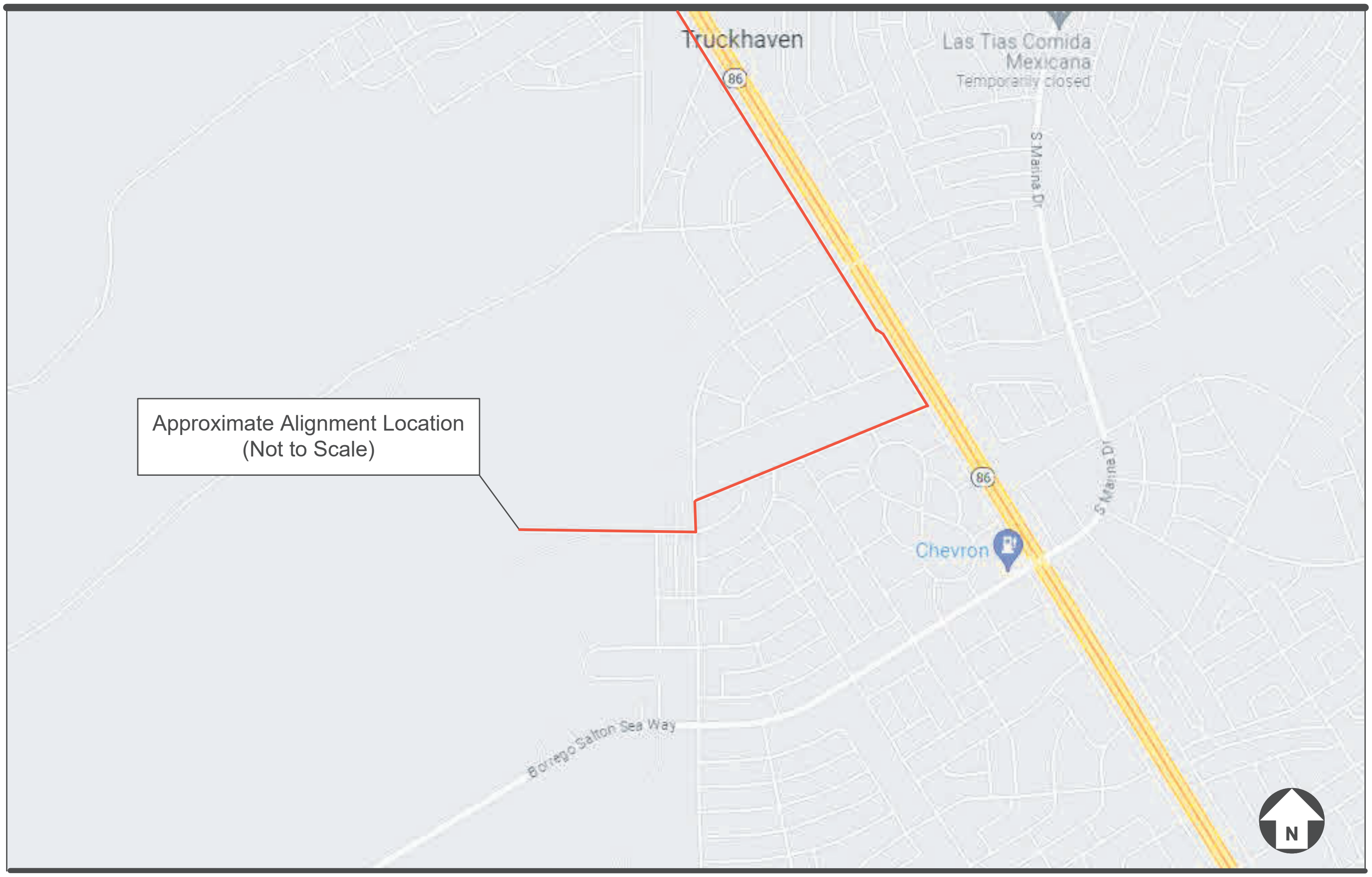
Figure No.
1f



Project: Highway 86 Water Transmission Main, Phase 3 & 4

Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

For: Albert A. Webb Associates

Approximate Alignment Location Map

Project No.
21-81-260-02

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Figure No.
1g

3.0 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.

3.1 Project Set-up

As part of the project setup, we conducted the following.

- Conducted an alignment reconnaissance within the project area and marked the borings so that drill rig access to all the locations was available.
- Obtained permit from Riverside County Transportation Department and California Department of Transportation (Caltrans).
- Notified Underground Service Alert (USA) at least 48 hours prior to the investigation to clear the locations of any conflict with existing underground utilities.
- Engaged a California-licensed driller to drill exploratory borings.

3.2 Subsurface Exploration

The subsurface exploration included borings and test pits.

Borings
Nineteen exploratory borings (BH-01 through BH-17, BH-01A and BH-06A) were drilled from July 10, 2023, to July 14, 2023, to investigate the subsurface conditions. The planned depths of the borings were between 15.0 and 30.0 feet below ground surface (bgs). The borings were drilled to the maximum depths between 3.5 and 31.5 feet bgs. Due to refusal on potential gravel, cobbles, and boulder, some of the borings were terminated at shallower depths. The borings details are presented in the following table.

Table No. 1, Summary of Borings

Boring No.	Boring Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
BH-01	15.0	6.0	N/E	7/11/23
BH-01A	15.0	13.0	N/E	7/11/23
BH-02	25.0	26.5	N/E	7/14/23
BH-03	25.0	26.5	N/E	7/10/23
BH-04	30.0	31.5	N/E	7/12/23
BH-05	15.0	16.5	N/E	7/10/23
BH-06	15.0	3.5	N/E	07/10/23
BH-06A	15.0	15.5	N/E	07/10/23

Boring No.	Boring Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
BH-07	15.0	15.5	N/E	07/10/23
BH-08	25.0	26.5	N/E	07/10/23
BH-09	30.0	31.5	N/E	07/11/23
BH-10	25.0	25.5	N/E	07/12/23
BH-11	25.0	26.5	N/E	07/14/23
BH-12	15.0	16.5	N/E	07/11/23
BH-13	15.0	16.5	N/E	07/11/23
BH-14	15.0	16.5	N/E	07/11/23
BH-15	15.0	16.5	N/E	07/13/23
BH-16	15.0	16.3	N/E	07/13/23
BH-17	15.0	15.7	N/E	07/13/23

Test Pits

Four exploratory test pits (TP-01 through TP-04) were excavated on August 3, 2023, using a backhoe equipped with a 3 feet-wide bucket. The test pits were excavated between 10.0 feet and 10.4 feet below the existing ground surface (bgs). The test pits details are presented in the following tables.

Table No. 2, Summary of Test Pits

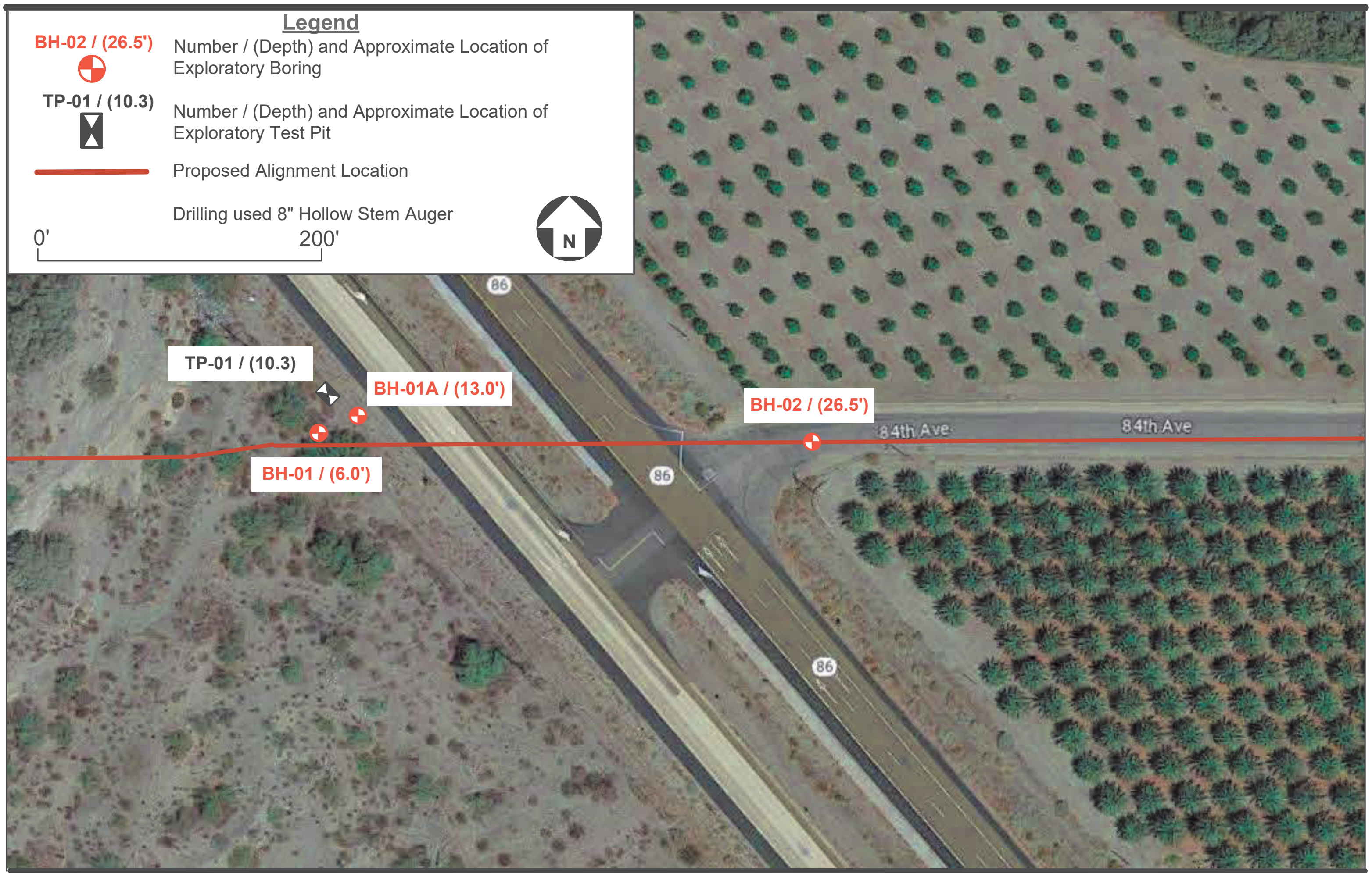
Test Pit No.	Test Pit Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
TP-01	10.0	10.3	N/E	08/03/23
TP-02	10.0	10.0	N/E	08/03/23
TP-03	10.0	10.3	N/E	08/03/23
TP-04	10.0	10.4	N/E	08/03/23

Approximate boring and test pit locations are indicated in Figure Nos. 2a through 2k, *Approximate Boring and Test Pit Locations Maps*. For a description of the field exploration and sampling program, see Appendix A, *Field Exploration*.

3.3 Laboratory Testing

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

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



Project: Highway 86 Water Transmission Main, Phase 3 & 4

Location: 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

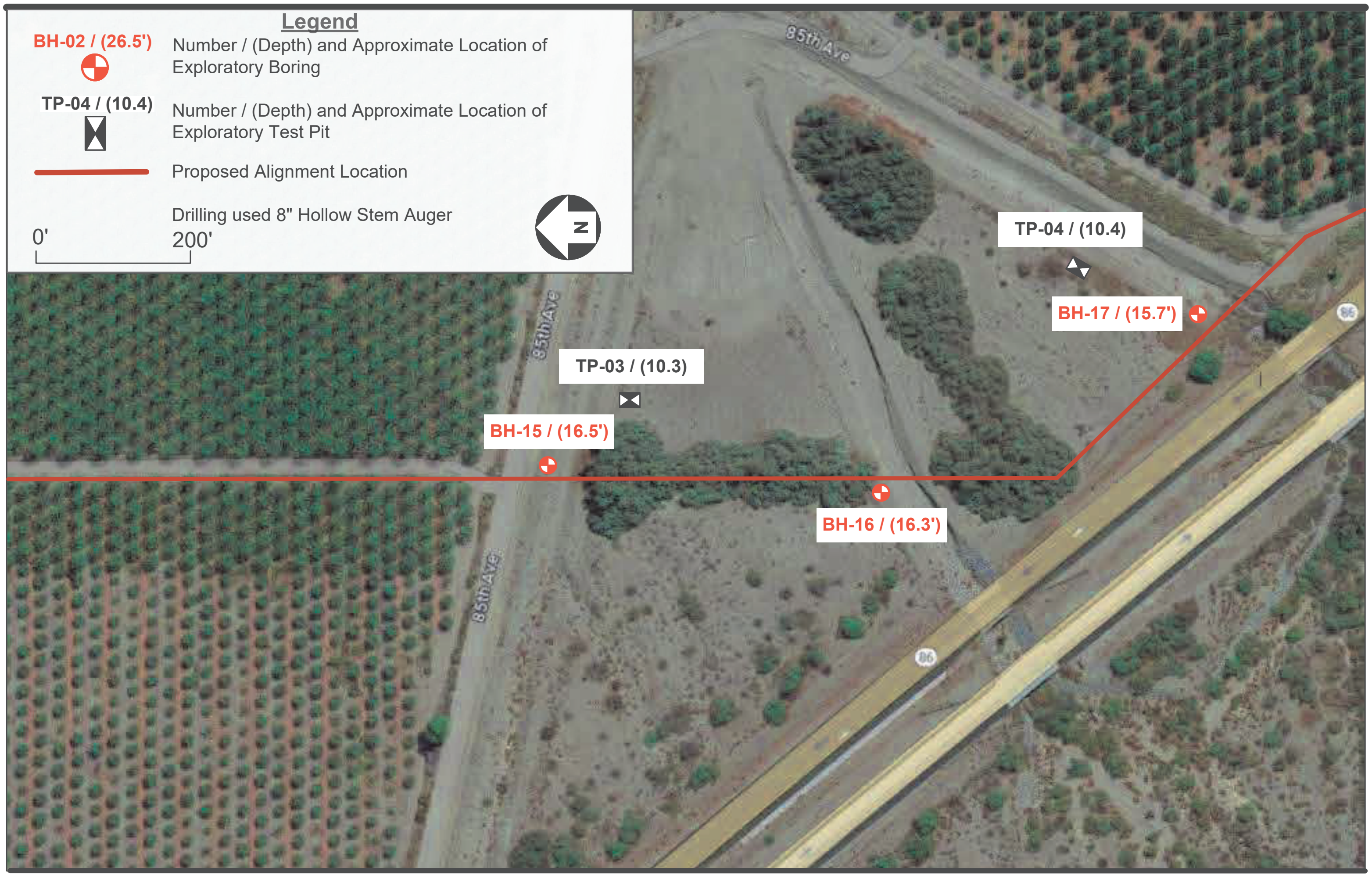
For: Albert A. Webb Associates

Approximate Boring and Test Pit Locations Map

Project No.
21-81-260-02

Converse Consultants

Figure No.
2a



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Converse Consultants

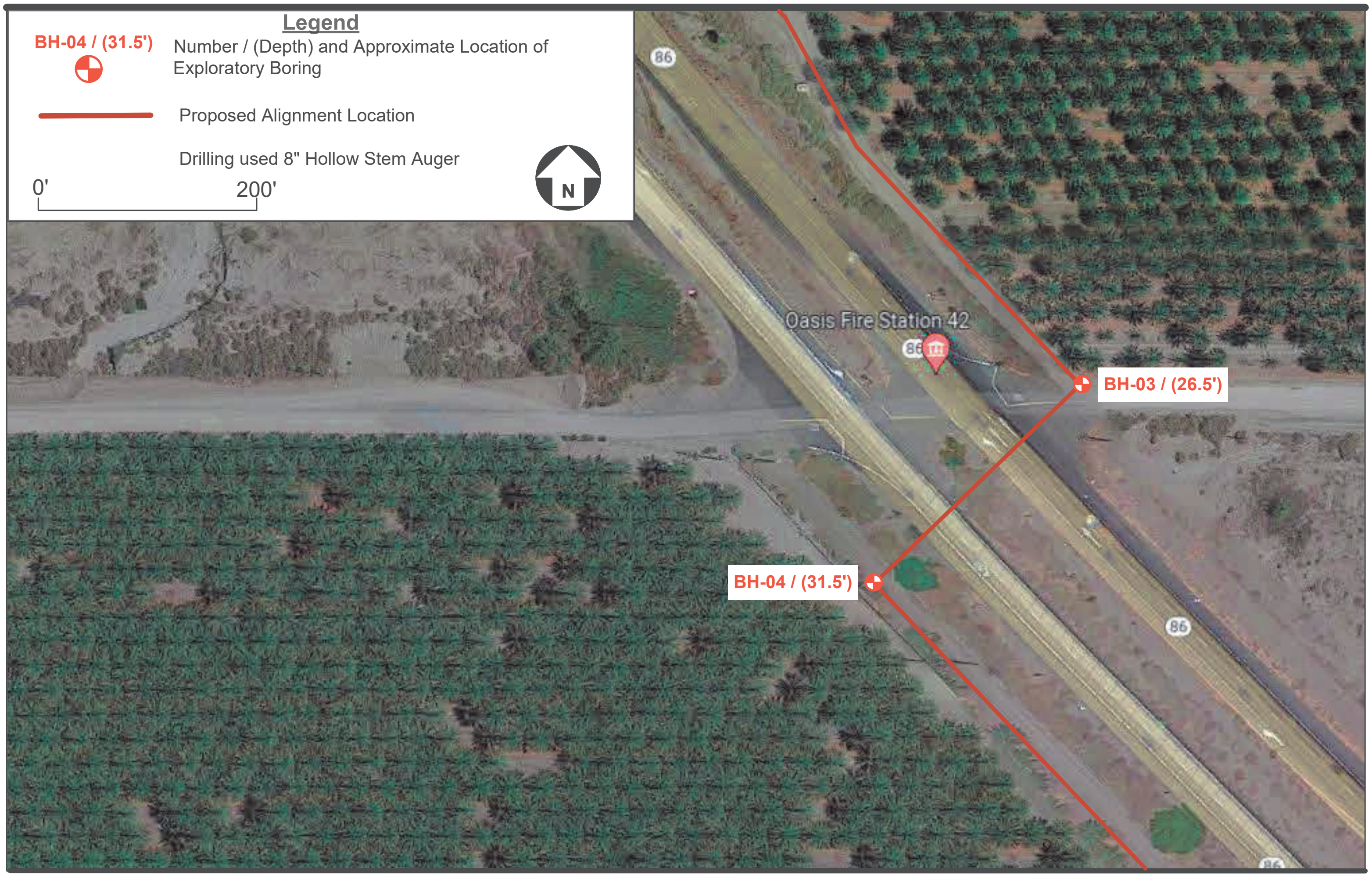
Figure No.
2b

Legend

BH-04 / (31.5') Number / (Depth) and Approximate Location of Exploratory Boring

Proposed Alignment Location

Drilling used 8" Hollow Stem Auger



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Converse Consultants

Figure No. 2c

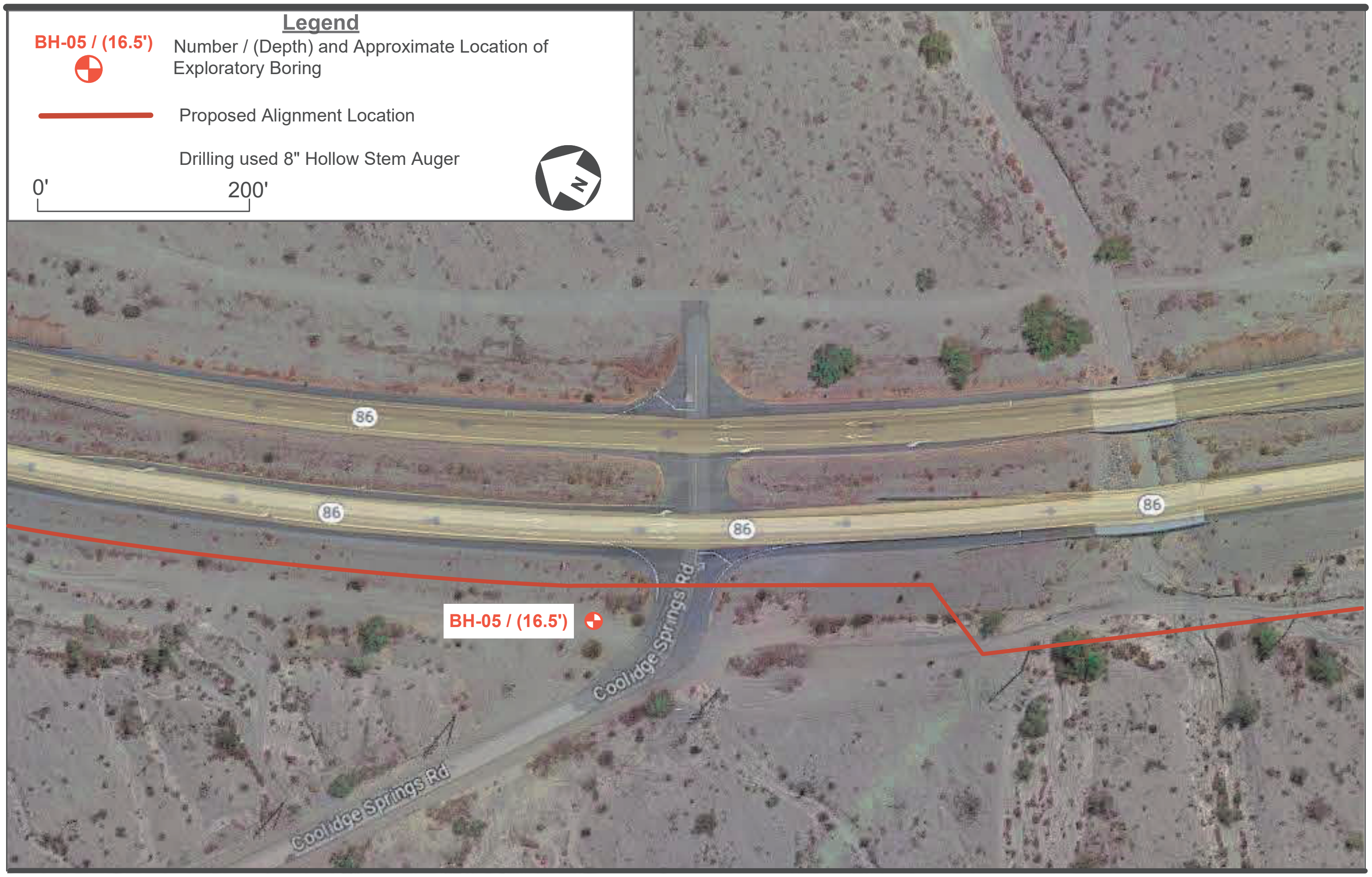

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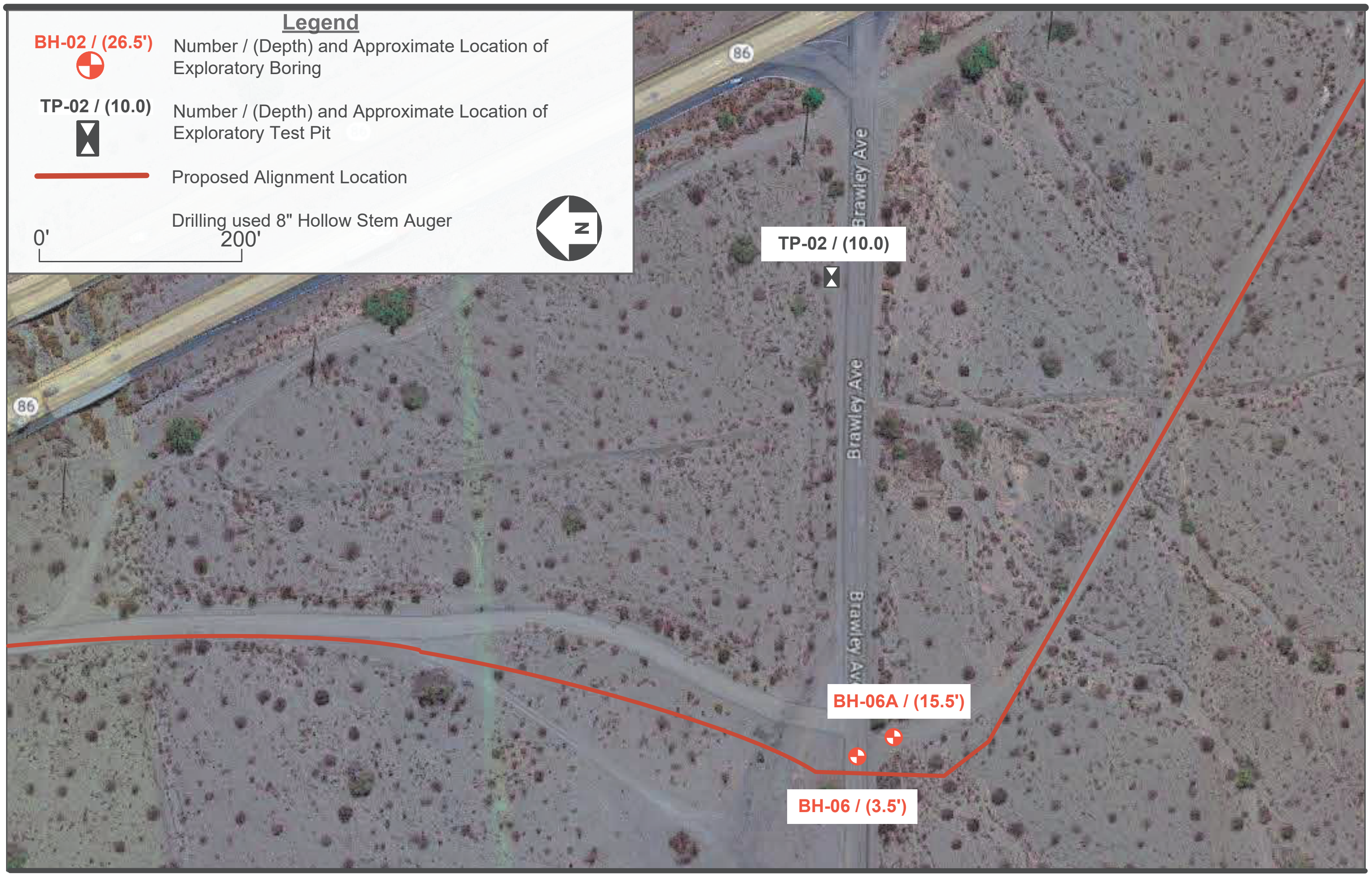
Figure No. 2d



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21-81-260-02

Converse Consultants

Figure No.
2e

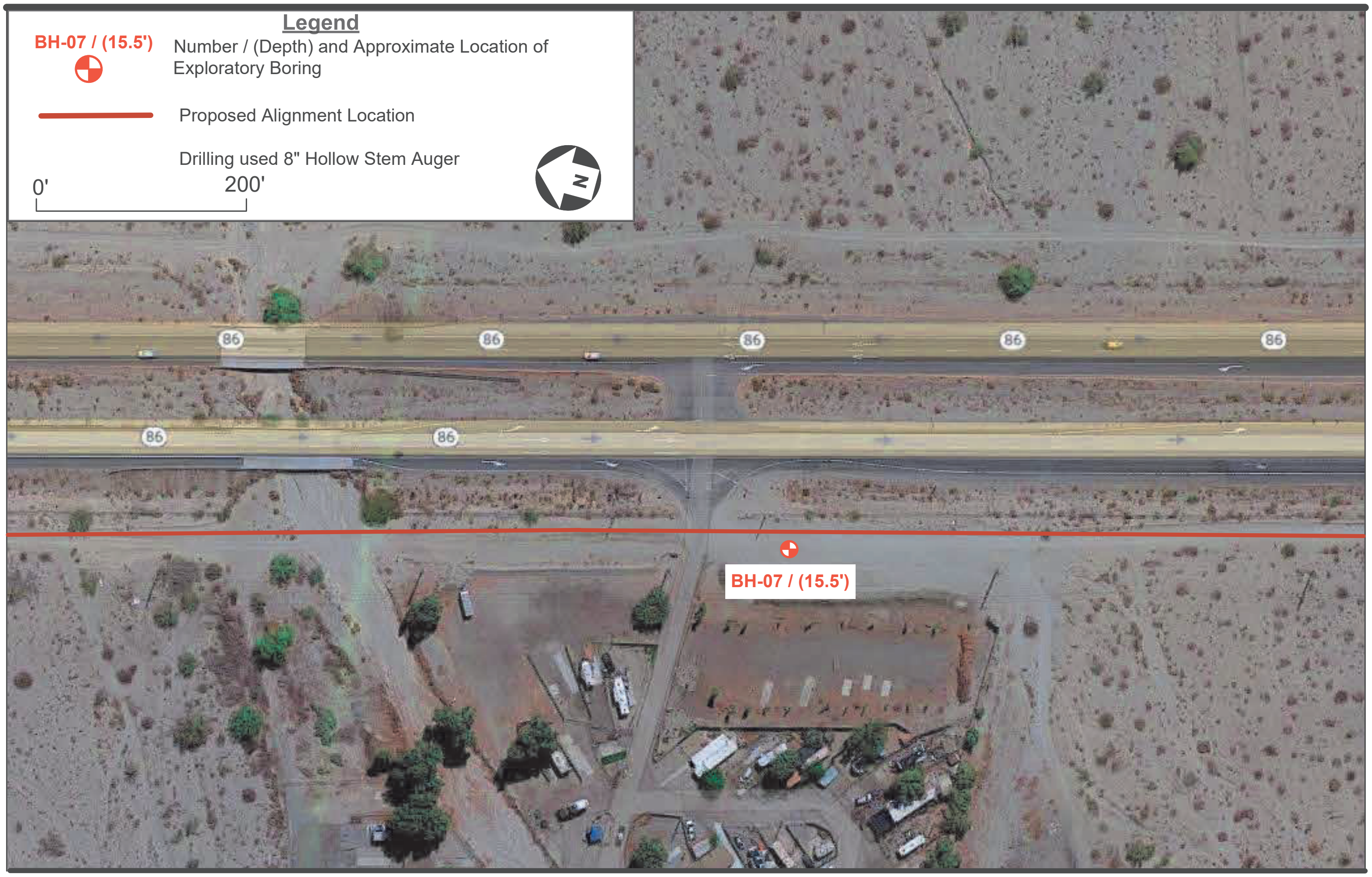

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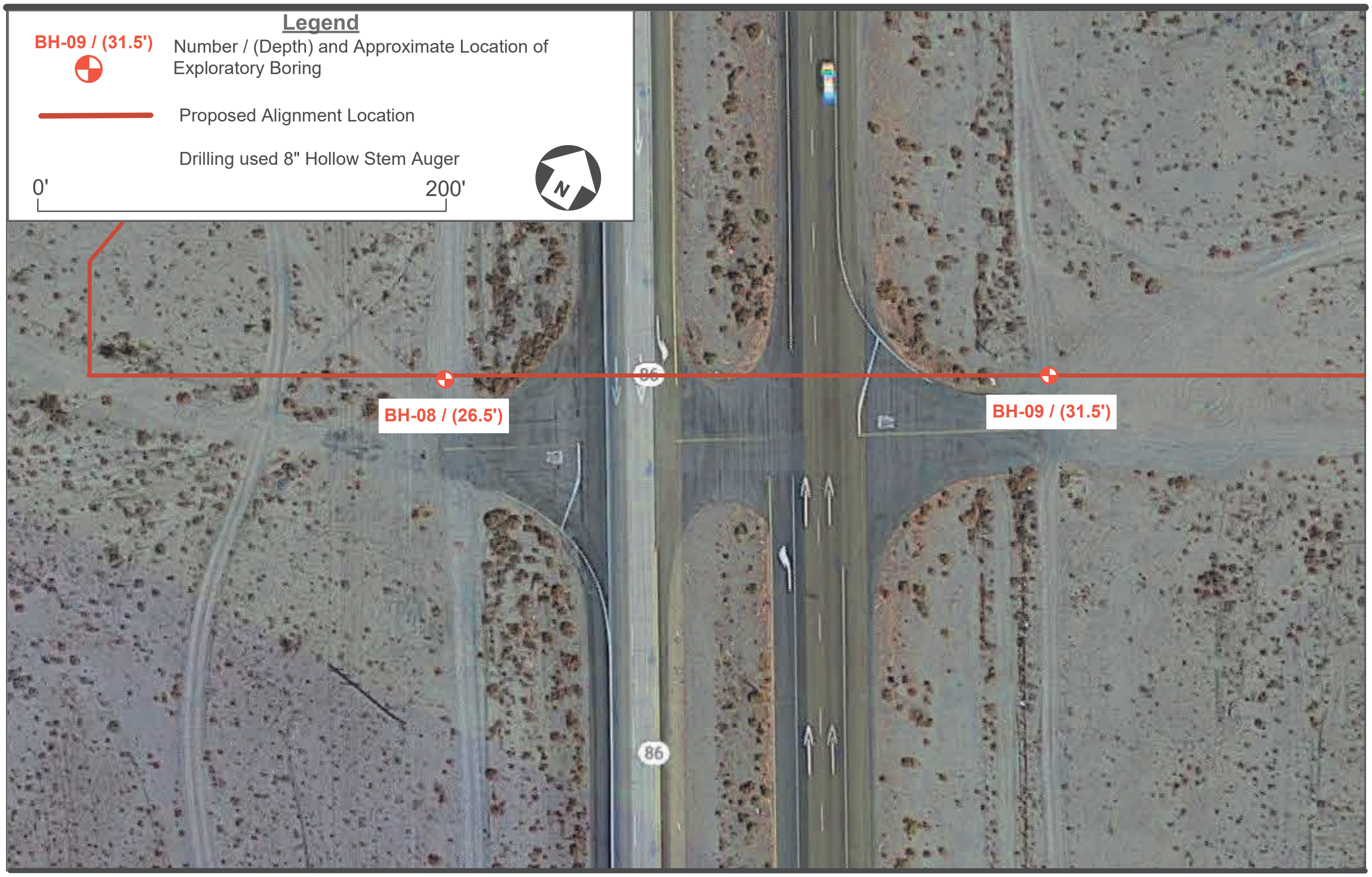
Figure No. 2f



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Approximate Boring and Test Pit Locations Map

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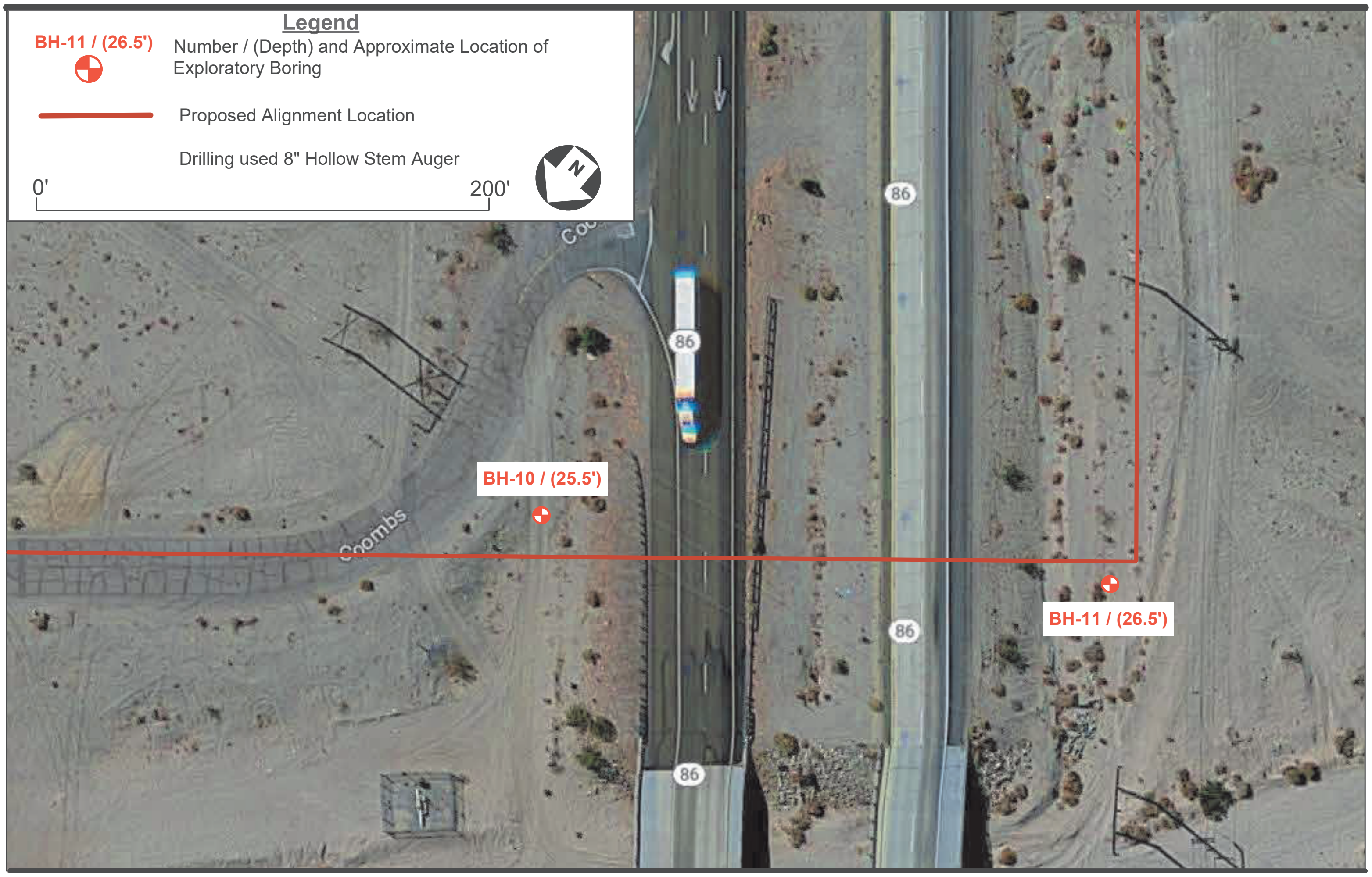
21-81-260-02

Converse Consultants

Figure No.
2g



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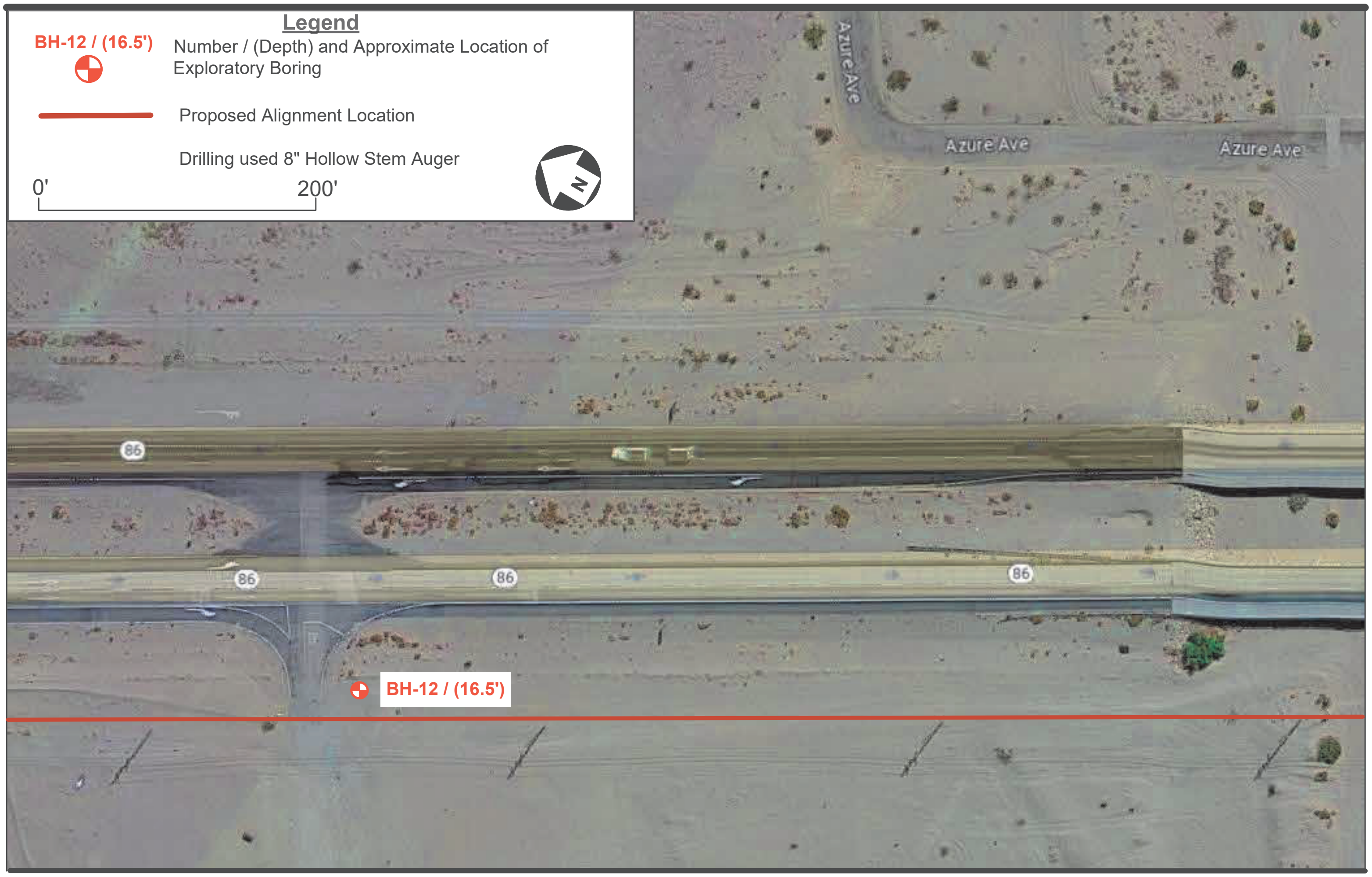
Approximate Boring and Test Pit Locations Map

Project No.
21-81-260-02

Converse Consultants

Figure No.
2h



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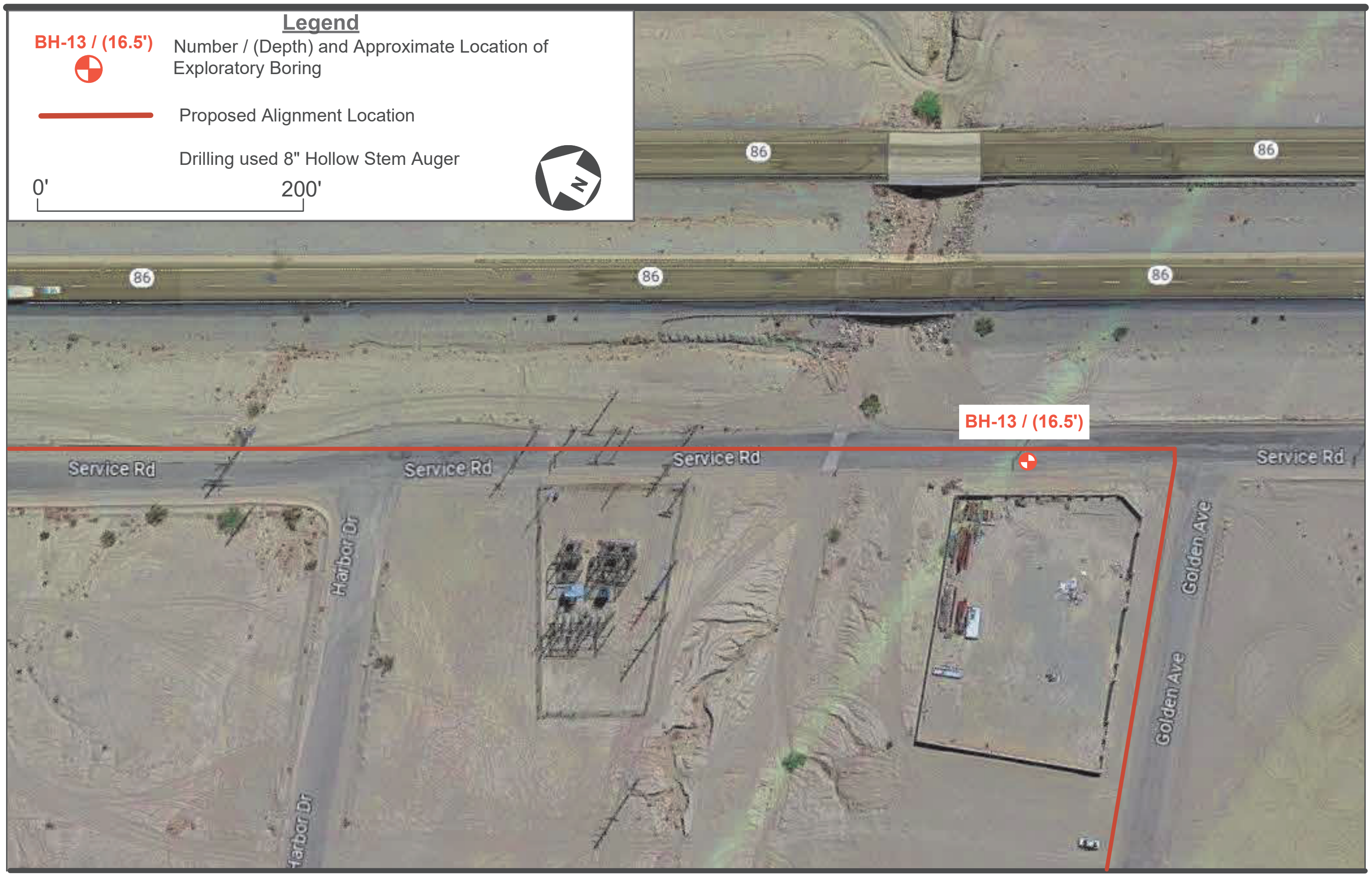
Approximate Boring and Test Pit Locations Map

Project No.
21-81-260-02

Converse Consultants

Figure No.
2i



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21-81-260-02

Converse Consultants

Figure No.
2j

Project: Highway 86 Water Transmission Main, Phase 3 & 4

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Approximate Boring and Test Pit Locations Map

Project No. 21-81-260-02

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Figure No. 2k

- Sieve Analysis (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 Borings and Test Pits in Appendix A, *Field Exploration*. For a description of the laboratory test methods and test results, see Appendix B, *Laboratory Testing Program.*

3.4 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 proposed project.

4.0 SURFACE CONDITIONS ALONG THE ALIGNMENT

The proposed pipeline alignment will connect 84th Avenue south to the CVWD Reservoir 1092 site located at the Salton Sea, Imperial County, California. The project is generally located along Highway 86 on the west side of the Salton Sea at the eastern Coachella Valley in Riverside County, California.

Within the project limit Highway 86 has two lanes in each direction with shoulders that are intersected by local collectors and streets. Desert vegetation, trees, wire fencing, and overhead utilities were observed along the alignment. Several locations have residential and commercial properties bounding the proposed pipeline location. The approximate elevation within the project limit is between -215 feet and 40 feet above mean sea level (amsl). *Photograph Nos. 1 through 3* presents some alignment conditions.

Photograph No. 1: Present alignment conditions.

Photograph No. 2: Present alignment conditions, facing southeast along Highway 86.


Photograph No. 3: Present alignment conditions, facing east towards Diamond Ave.

4.1 Subsurface Profile

Based on the exploratory borings, test pits and laboratory test results, the subsurface soil within the project area primarily consisted of a mixture of sand, silt, clay, gravel up to 2.75 inches, cobbles up to 12 inches and boulders up to 24 inches in largest dimensions. See Photograph Nos. 1 through 7 in Appendix C, *Excavated Soil Photos* for the sizes of excavated soils.

Discernible fill soils were not identified in our subsurface exploration; however, the site may have been previously graded for the existing development (pavement) and fill soil is likely present in some locations. If present, the fill soils were likely derived from on-site sources and are similar to the native soils in composition and density.

For a detailed description of the subsurface materials encountered in the exploratory borings, see Drawings No. A-2 through A-24, Logs of Borings and Test Pits, in Appendix A, Field Exploration.

4.2 Excavatability

The surface and subsurface soil materials for the proposed project are expected to be excavatable by conventional heavy-duty earth moving equipment. Excavation will be difficult where concentrations of gravel, cobbles and boulders are higher.

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

4.3 Groundwater

Groundwater was not encountered during the investigation to the maximum explored depth of 31.5 feet bgs. Regional conditions were reviewed using the general coordinates (33.440460, -116.074756; 33.360277, -116.019309; and 33.279827, -115.978665) to estimate expected groundwater depths in the vicinity of the proposed project.

For comparison, regional groundwater data from the GeoTracker database (SWRCB, 2023) was reviewed to evaluate the current and historical groundwater levels. No site with groundwater data was identified within a 1.0-mile radius of the project site.

The National Water Information System (USGS, 2023) was reviewed for current and historical groundwater data from sites within an approximately 1.0-mile radius of the proposed alignment and no data was found.

The California Department of Water Resources database (DWR, 2023) was reviewed using general coordinates (33.440460, -116.074756) for historical groundwater data from sites within a 1.0-mile radius of the project site. One site was identified within a 1.0-mile radius of the project site that contained groundwater elevation data. Details of that record are listed below.

- Well No. KW_056 (Station 334523N1160836W001), located approximately 5,073 feet northwest of the project site, reported groundwater at a depth ranging from 10.7 to 114 feet bgs between 1965 and 2023.

Based on available data, the historical high groundwater level reported at wells within approximately one mile of the project area was approximately 10.7 feet bgs. Current groundwater is expected to be deeper than 33.5 feet bgs. Groundwater is not expected to be encountered during construction. It should be noted that the groundwater level could vary depending upon the seasonal precipitation and possible groundwater pumping activity in the vicinity. Shallow perched groundwater may be present locally, particularly following precipitation or irrigation events.

4.4 Subsurface Variations

Based on results of the subsurface exploration and our experience, some variations in the continuity and nature of subsurface conditions within the project area 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.

5.0 ENGINEERING GEOLOGY

The regional and local geology within the proposed project area is discussed below.

5.1 Regional Geology

The project area is located in the Colorado Desert Province of Southern California.

The Colorado Desert Geomorphic Province consists of a low-lying barren desert basin dominated by the Salton Sea bounded in the north by the Little San Bernardino Mountains, on the west by the Santa Rosa Mountains, on the east by the Salton Sea, and in the south by the US-Mexican Border.

The province is a seismically active region characterized by a series of southeast-trending strike-slip faults. The most prominent of the nearby fault zones include the San Andreas, San Jacinto, and Elsinore Fault, 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 southeast-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.

5.2 Local Geology

Review of geologic maps indicate the proposed project alignment is underlain by Holocene-aged alluvial sediments (Qa) consisting of alluvial sand and clay in valley areas (Dibblee and Minch, 2008).

5.3 Flooding

Review of National Flood Insurance Rate Maps indicates that the proposed project area is within Flood Hazard Zones "A" and “AO”. The Zone “A” in this area is designated as a “Special Flood Hazard Area Without Base Flood Elevation (BFE)”. The Zone “AO” in this area is designated as a “Special Flood Hazard Area Regulatory Floodway” including areas of “Cross Sections with 1% Annual Chance” (FEMA, 2008).

6.0 FAULTING AND SEISMICITY

The location of the faults with respect to the project area and its impact is discussed in the following sections.

6.1 Faulting

The proposed project area is 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 area. During the life of the project, seismic activity associated with active faults can be expected to generate moderate to strong ground shaking within the project area. Review of recent seismological and geophysical publications indicates that the seismic hazard for the project is high.

The proposed project area is not located within a currently mapped State of California Earthquake Fault Zone for surface fault rupture. Table No. 3, *Summary of Regional Faults,* summarizes selected data of known faults capable of seismic activity within 100 kilometers of the project area. The data presented below was calculated using generalized coordinates 33.360277°N latitude and 116.019309°W longitude, the National Seismic Hazard Maps Database (USGS, 2008) and other published geologic data.

Table No. 3, Summary of Regional Faults

Fault Name	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
S. San Andreas	19.19	strike slip	548	n/a	8.18
San Jacinto	23.94	strike slip	241	n/a	7.88
Elmore Ranch	35.15	strike slip	29	1.0	6.70

Fault Name	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
Superstition Hills	37.92	strike slip	36	4.0	6.80
Earthquake Valley	48.69	strike slip	20	2.0	6.80
Elsinore	52.03	strike slip	241	n/a	7.85
Imperial	64.92	strike slip	46	20	7.00
Laguna Salada	71.35	strike slip	99	3.5	7.30
Burnt Mtn	72.48	strike slip	21	0.6	6.80
Eureka Peak	73.07	strike slip	19	0.6	6.70
Pinto Mtn	83.04	strike slip	74	2.5	7.30
Pisgah-Bullion Mtn-Mesquite Lk	86.17	strike slip	88	0.8	7.30
So Emerson-Copper Mtn	89.72	strike slip	54	0.6	7.10
Calico-Hidalgo	90.97	strike slip	117	1.8	7.40
Landers	97.07	strike slip	95	0.6	7.40

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

6.2 CBC Seismic Design Parameters

Seismic parameters based on the California Building Code (CBC, 2022) and ASCE 7-16 are provided in the following table. These parameters were determined using coordinates North Bound (33.405305N, 116.045923W), Center Bound (33.354534N, 116.017749W), and South Bound (33.300943N, 115.980861W) and the Seismic Design Maps online application ATC tool.

Table No. 4, CBC Seismic Design Parameters

Parameter	Value		
	North Bound	Center Bound	South Bound
Site Coordinates	33.405305N, 116.045923W	33.354534N, 116.017749W	33.300943N, 115.980861W
Risk Category	II	II	II
Site Class	D	D	D
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_s	1.500g	1.500g	1.500g
Mapped 1-second Spectral Response Acceleration, S_1	0.589g	0.595g	0.600g

Parameter	Value		
	North Bound	Center Bound	South Bound
Site Coefficient (Table 1613A.3.3.(1)), F_a	1.000	1.000	1.000
Site Coefficient (Table 1613A.3.3.(2)), F_v	1.705	1.711	1.700
MCE 0.2-sec period Spectral Response Acceleration, S_{Ms}	1.500g	1.500g	1.500g
MCE 1-second period Spectral Response Acceleration, S_{M1}	1.000g	1.000g	1.000g
Design Spectral Response Acceleration for short period S_{ds}	1.004g	1.018g	1.020g
Design Spectral Response Acceleration for 1-second period, S_{d1}	0.669g	0.769g	0.680g
Site Modified Peak Ground Acceleration, PGA_M	0.550g	0.550g	0.581g

6.3 Secondary Effects of Seismic Activity

In addition to ground shaking, effects of seismic activity on a project site may include surface fault rupture, soil liquefaction, landslides, lateral spreading, seismic settlement, tsunamis, seiches and earthquake-induced flooding. Results of a site-specific evaluation of each of the above secondary effects are explained below.

Surface Fault Rupture: The proposed project area is not located within a currently designated State of California Fault Zone (CGS, 2007). The project site is located approximately 16 miles from an active fault zone and is adjacent to the Santa Rosa Mountains that are assigned a moderate earthquake hazard level by the San Diego County Know Your Hazards Map (San Diego County, 2023). The potential for surface rupture resulting from the fault activity is considered to be low to moderate.

Liquefaction: Liquefaction is defined as the phenomenon in a soil mass, because of the development of excess pore pressures, soil mass suffers a substantial reduction in its shear strength. 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 in submerged granular soils 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 primarily granular,
- Soils must be contractive, that is, loose to medium-dense,
- Ground motion must be intense,
- Duration of shaking must be sufficient for the soils to lose shear resistance.

The proposed project area is not located within a zone designated as susceptible to liquefaction by the State of California (CGS, 2007).

Seismic Settlement: Dynamic dry settlement may occur in loose, granular, unsaturated soils during a large seismic event. Based on the relatively dense and occasional cohesive soil conditions, the potential of seismic settlement is considered low.

Landslides: Seismically induced landslides and other slope failures are common occurrences during or after earthquakes in areas of significant relief. The proposed project area is adjacent to hillsides but is not designated in a State of California landslide area (CGS, 2007). In the absence of significantly steep ground slopes, the potential for seismically induced landslides to affect the proposed project area is considered to be low.

Lateral Spreading: Seismically induced lateral spreading involves primarily lateral movement of earth materials due to ground shaking. It differs from slope failure in that complete ground failure involving large movement does not occur due to the relatively smaller gradient of the initial ground surface. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. Due to low liquefaction potential, the risk for lateral spreading to affect the project area is considered low.

Tsunamis: Tsunamis are tidal waves generated in large bodies of water by fault displacement or major ground movement. The project site is not designated in a State of California Tsunami Hazard Area (CGS, 2007), tsunamis do not pose a hazard to this project area.

Seiches: Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Review of the project area indicates that there is one up gradient body of water with the potential of flooding the project area. The Salton Sea is less than 1 mile east of the project site. Due to the enclosed water body near the proposed project area, seiches may pose a hazard to this project area.

Earthquake-Induced Flooding: This is flooding caused by the failure of dams or other water-retaining structures as a result of earthquakes. The proposed project area is not located in a designated State of California Dam Inundation Zone (DWR, 2021). The potential for flooding of the project due to dam failure is considered to be low.

7.0 LABORATORY TEST RESULTS

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

7.1 Physical Testing

Results of the various laboratory tests are presented in 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.* The results are also discussed below.

- In-situ Moisture and Dry Density: In-situ dry densities and moisture contents of the site soils were determined in accordance with ASTM Standard D2216 and D2937. Dry densities of the upper 15 feet alluvium soils ranged from 83 to 147 pounds per cubic foot (pcf) with moisture contents of 1 to 15 percent.
- Sand Equivalent: Ten representative soil samples were tested in accordance with the ASTM Standard D2419 test method to determine the sand equivalent. The test results ranged from SE of 2 to 53.
- Grain Size Analysis: Ten representative samples were tested to determine the relative grain size distribution in accordance with the ASTM Standard D6913. The test results are graphically presented in Drawing No. B-1a and B-1b, *Grain Size Distribution Results.*
- Maximum Dry Density and Optimum Moisture Content: Typical moisture-density relationship tests were performed on six representative samples in accordance with ASTM D1557. The results are presented in Drawing No. B-2a and B-2b, *Moisture-Density Relationship Results*, in Appendix B, *Laboratory Testing Program*. The laboratory maximum dry densities were between 115.0 and 130.0 pcf and the optimum moisture contents between 6.0 and 17.0 percent.
- Direct Shear: Five direct shear tests were performed on undisturbed and remolded representative ring samples under soaked moisture condition in accordance with ASTM Standard D3080. The results are presented in Drawings No. B-3 through B-7, *Direct Shear Test Results* in Appendix B, *Laboratory Testing Program*.

7.2 Chemical Testing - Corrosivity Evaluation

Seven soil samples were tested to determine minimum electrical resistivity, pH, and chemical contents, 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 California Test Methods 643, 422, and 417. The test results are summarized in the following table and are presented in Appendix B, *Laboratory Testing Program.*

- The pH measurements of the samples tested were between 8.5 and 9.8.
- The sulfate contents of the samples tested were between 20 and 2023 ppm.
- The chloride concentrations of the samples tested were 18 and 1287 ppm.
- The minimum electrical resistivities when saturated were 207 and 5,564 ohm-cm.

8.0 EARTHWORK RECOMMENDATIONS

Earthwork for the project will include the following.

8.1 General

Prior to the start of construction, all existing underground utilities and appurtenances should be located within the project alignment. 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.

Deleterious material, including organics and debris generated during excavation, should not be placed as fill.

Migration of fines from the surrounding native soils, in the case of water leaks 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.

8.2 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 in dimension, if any, should be removed from the trench bottom and replaced with compacted on-site 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.

8.3 Pipe Bedding

Bedding is defined as the material supporting and surrounding the pipe to one foot above the pipe. Pipe bedding should follow the Coachella Valley Water District Standards. The following specifications are recommended to provide a basis for quality control during the placement of pipe bedding.

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. Typically, soils with sand equivalent value of 30 or more are used as pipe bedding material. Based on laboratory test results, the soils along the alignments may be suitable for use as 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 minus 75 µm (No. 200) sieve 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

D50(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.

8.4 Backfill Materials

Backfill materials should follow the Coachella Valley Water District Standards and Caltrans specifications. Additional information, if required, is presented below.

The native soils encountered within the pipeline alignment, free of debris or organic matter are suitable as compacted fill after proper processing and removal of oversize materials to 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 30 percent by weight retained in 3/4-inch sieve.
- Contain less than 40 percent fines (passing #200 sieve).

Based on field investigation and laboratory testing results, on-site soils may not be suitable for pipe bedding. However, on-site soils may be suitable as structural fill materials provided appropriate corrosion mitigation will be applied.

Imported soils, if used as fill, should be predominantly granular and meet the above criteria. Any imported fill should be tested and approved by geotechnical representative prior to delivery to the alignments.

8.5 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.

At least the upper 12 inches of subgrade soils underneath pavements intended to support vehicle loads should be scarified, moisture conditioned, and compacted to at least 95 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.

8.6 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 backfills should follow Coachella Valley Water District Standards. The following specifications are recommended to provide a basis for quality control during the placement of trench backfill.

- 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 3 inches 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 6 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.

8.7 Backfill of Jacking and Receiving Pits

The bore-and-jack crossings (BH-01A, BH-02 through BH-04, and BH-08 through BH-11) will require jacking and receiving pits. We anticipate that the depths of the boring/jacking and receiving pits will be approximately 8 to 12 feet below the existing grade. The pits should be backfilled following construction of the pipe crossings.

The pit bottoms should be free of trash, debris or other unsatisfactory materials at the time of backfill placement. The bottoms of the excavations should be scarified to a minimum depth of 12 inches below subgrade, moisture conditioned to within 3 percent of optimum moisture content, and recompacted to at least 90 percent of the laboratory maximum dry density.

The backfill soils should be well-blended, and moisture conditioned to within 3 percent of optimum moisture content. Particles larger than 6 inches should not be used as backfill materials. The backfill should be placed in loose lifts not exceeding 8 inches in thickness and compacted to at least 90 percent of the laboratory maximum dry density per ASTM Standard D1557. If the ground surface is to be paved, the backfill within 12 inches of the pavement subgrade should be compacted to at least 95 percent of the laboratory maximum dry density. Shoring should be removed gradually while backfilling to prevent side soils from caving.

The contractor should select the equipment and processes to be used to achieve the specified density without damage to adjacent ground, existing facilities, utilities, or completed work.

9.0 DESIGN RECOMMENDATIONS

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

9.1 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.

9.2 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. 5, 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	0.30

9.3 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. 6, Soil Parameters for Pipe Design

Soil Parameters	Value
Average compacted fill total unit weight (assuming 92% relative compaction), γ (pcf)	127.0
Angle of internal friction of soils, ϕ	31
Soil cohesion, c (psf)	0
Coefficient of friction between concrete and native soils, fs	0.40
Coefficient of friction between CML&C steel pipe and native soils, fs	0.30
Bearing pressure against native soils (psf)	2,500
Coefficient of passive earth pressure, Kp	3.12
Coefficient of active earth pressure, Ka	0.32
Modulus of Soil Reaction E’ (psi)	1,500

9.4 Bearing Pressure for Anchor and Thrust Blocks

An allowable net bearing pressure presented in Table No. 6, *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.

9.5 Soil Corrosivity

Seven representative soil samples were evaluated for corrosivity with respect to common construction materials such as concrete and steel. The test results are presented in Appendix B, *Laboratory Testing Program* and design recommendations pertaining to soil corrosivity are presented below.

The sulfate contents of the sampled soils correspond to American Concrete Institute (ACI) exposure category S0 and S2 (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 for S0. Concrete type restrictions are specified for exposure category S2 (ACI 318-14, Table 19.3.2.1). A minimum compressive strength of 4,500 psi is recommended for S2.

We anticipate that concrete structures will be exposed to moisture from precipitation and irrigation. Based on the project location and the results of chloride testing of the soils, we do not anticipate that concrete structures 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. 7, 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 measured values of the minimum electrical resistivity of the samples when saturated were between 207 and 5,564 ohm-cm. This indicates that the soils tested are Severe to Moderately corrosive to ferrous metals in contact with the soil (Romanoff, 1957). Converse does not practice in the area of corrosion consulting. A qualified corrosion consultant should provide appropriate corrosion mitigation measures for any ferrous metals in contact with the site soil.

9.6 Asphalt Concrete Pavement

Based on the soil type we assumed an R-value of 50 and Traffic Indices (Tis) ranging from 5 to 10 in pavement design.

Based on the above information, asphalt concrete and aggregate base thickness are determined using the *Caltrans Highway Design Manual (Caltrans, 2022)*, Chapter 630 with a safety factor of 0.2 for asphalt concrete/aggregate base section and 0.1 for full depth asphalt concrete section. Preliminary asphalt concrete pavement sections for each street are presented in the following table.

Table No. 8, Recommended Preliminary Pavement Sections

Design R-value	Traffic Index (TI)	Pavement Section		
		Asphalt Concrete (inches)	Aggregate Base (inches)	Full AC Section (inches)
50	5.0	3.0	2.0	4.0
	6.0	3.5	3.5	5.0
	7.0	4.0	4.5	6.5
	8.0	5.0	5.0	7.5
	9.0	6.0	5.5	8.5
	10.0	7.0	6.0	9.5

Pavement sections should follow Coachella Valley Water District Standards and Caltrans Standards, or Table No. 8, *Recommended Preliminary Pavement Sections*, whichever is determined to be applicable. At or near the completion of trench backfill, the street subgrade should be tested to evaluate the actual subgrade R-value for final pavement design.

Prior to placement of aggregate base or asphalt concrete, at least the upper 12 inches of subgrade soils should be scarified, moisture-conditioned if necessary, and recompacted to at least 95 percent of the laboratory maximum dry density as defined by ASTM Standard D1557 test method.

Base materials should conform to Section 200-2.2,"*Crushed Aggregate Base*," of the current Standard Specifications for Public Works Construction (SSPWC; Public Works Standards, 2021) or Coachella Valley Water District Standards, whichever is applicable and should be placed in accordance with Section 301-2 of the SSPWC.

Asphaltic concrete materials should conform to Section 203 of the SSPWC or the Coachella Valley Water District Standards, whichever is applicable and should be placed in accordance with Section 302-5 of the SSPWC.

9.7 Rigid Pavement Recommendations

Based on the soil type we assumed an R-value of 50 and Traffic Indices (Tis) ranging from 5 to 10 in pavement design. We recommend that the project structural engineer consider the loading conditions at various locations and select the appropriate pavement sections from the following table.

Table No. 9, Rigid Pavement Structural Sections

Design R-Value	Design Traffic Index (TI)	PCCP Pavement Section (inches)
50	5.0	6.0
	6.0	6.5
	7.0	6.5
	8.0	7.0
	9.0	7.5
	10.0	7.5

Prior to placement of aggregate base, at least 2 feet to 3 feet of the soils below existing grade should be removed, processed, and replaced as compacted fill prior to placing addition fill to reach finish grade, and recompacted to at least 95 percent of the laboratory maximum dry density as defined by ASTM Standard D1557 test method.

Positive drainage should be provided away from all pavement areas to prevent seepage of surface and/or subsurface water into pavement base and/or subgrade.

At or near the completion of grading, subsurface samples should be tested to evaluate the actual subgrade R-value for final pavement design.

The concrete pavement section is based on a minimum 28-day Modulus of Rupture (M-R) of 550 psi and a compressive strength of 3,000 psi. The third point method of testing beams should be used to evaluate modulus of rupture. The concrete mix design should contain a minimum cement content of 5.5 sacks per cubic yard. Recommended maximum and minimum values of slump for pavement concrete are three inches and one inch, respectively.

Transverse contraction joints should not be spaced more than 15 feet and should be cut to a depth of ¼ the thickness of the slab. Longitudinal joints should not be spaced more than 12 feet apart. A longitudinal joint is not necessary in the pavement adjacent to the curb and gutter section.

Concrete materials should conform to Section 201 of the 2021 Standard Specifications for Public Works Construction (SSPWC; Public Works Standards, 2018), and concrete pavement should be constructed in accordance with Section 302-6, “Portland Cement Concrete Pavement” of the SSPWC.

9.8 Jacking Force

The pipe jacking force is function of ground behavior, soil conditions, over burden pressure, pipe weight, size, annular space between pipe and soil, lubricant of the pipe, and installation time. The jacking force is equal to penetration resistance plus frictional resistance. Proper assessment of jacking force is required to design and select jacking pipes and thrust block.

The penetration resistance varies along the bore-and-jack depending on soil type and shape and steering action of the boring head.

Presence of concentrated gravel in the path of bore-and-jack operation can bring a sudden increase in the jacking force. Therefore, installation of pressure relief valves at the pit and indicators on the control panel is desirable to ensure that the allowable jacking force is not exceeded.

Design parameters presented Table No. 10, *Jacking System Design Parameters*, may be used to design jacking force system.

Table No. 10, Jacking System Design Parameters

Parameter	Value
Bearing Pressure (psf)	2,500
At-rest Lateral Earth Pressure (psf)	61
Passive Earth Pressure (psf)	250
Soil Unit weight (pcf)	135
Friction, between soil and steel	0.35

We recommend that the ultimate compressive strength of the pipe should be at least 2.5 times the design jacking loads of the pipe.

The pipe designer should determine an appropriate factor of safety to be incorporated into the design of thrust block. The bore-and-jack contractor is responsible for selection of jacking force system and the final design of thrust blocks.

The jacking operations should always be controlled to minimize loss of ground. Steel casing sections should be jacked forward concurrently with the boring operation to provide continuous ground support.

A welded steel pipe casing is required to be installed at the crossing location. The annulus should be injected with cellular concrete or grout to fill any possible voids created by the crossing operation.

10.0 CONSTRUCTION CONSIDERATIONS

Construction recommendations are presented below.

10.1 General

Prior to the start of construction, all existing underground utilities should be located along the project area. 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 within the project area. 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.

10.2 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. 11, Slope Ratios for Temporary Excavations

Soil Type	OSHA Soil Type	Depth of Cut (feet)	Recommended Maximum Slope (Horizontal:Vertical)[1]
Silty Sand (SM), Clayey Sand (SC), Sandy Silt (ML), Sand with Silt and Gravel (SP-SM)	C	0-12	1.5:1
		12-20	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.

10.3 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.

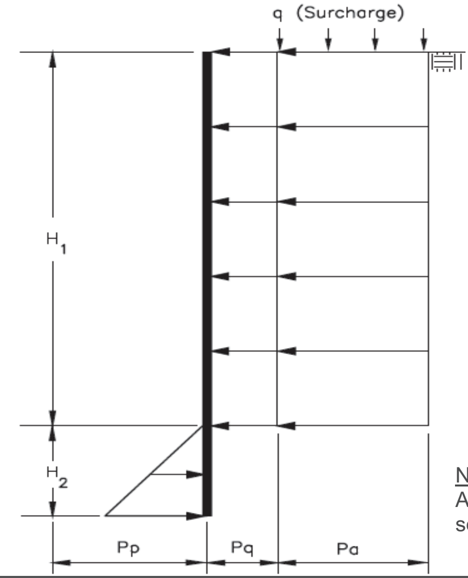
Table No. 12, Lateral Earth Pressures for Temporary Shoring

Lateral Resistance Soil Parameters*	Value
Active Earth Pressure (Braced Shoring) (psf) (A)	27
Active Earth Pressure (Cantilever Shoring) (psf) (B)	41
At-Rest Earth Pressure (Cantilever Shoring) (psf) (C)	61
Passive earth pressure (psf per foot of depth) (D)	250
Maximum allowable bearing pressure against native soils (psf) (E)	2,000
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

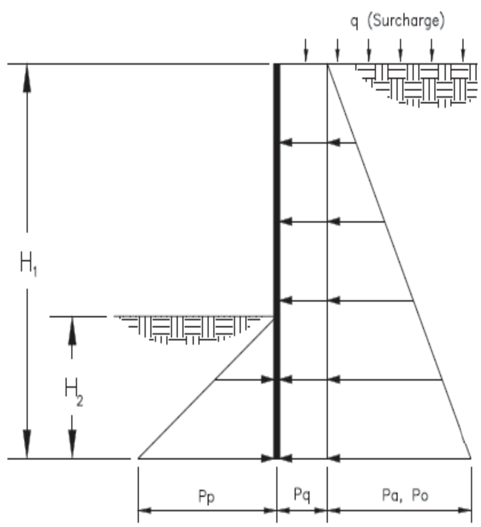
Pp = (D) H_2 ≤ (E) psf - passive earth pressure (on native soils)

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.

10.4 Trenchless Pipe Crossing Recommendations

Trenchless pipe crossing recommendations are presented in the following subsections.

10.4.1 Ground Classification for Trenchless Pipe Crossing

The Tunnelman’s Ground Classification (USDOT, 2009) categorizes predictive soil behaviors for saturated and unsaturated conditions as presented in Table No. 13, *Tunnelman’s Ground Classification for Soils*.

Table No. 13, Tunnelman's Ground Classification for Soils

Ground Classification	Ground Behavior	Typical Soil Types
Hard	Tunnel heading may be advanced without roof support.	Cemented sand and gravel and over-consolidated clay above the ground water table.
Firm	Heading can be advanced without initial support, and final lining can be constructed before ground starts to move.	Loess above water table; hard clay, marl, cemented sand and gravel when not highly overstressed.
Raveling	Chunks or flakes of material begin to drop out of the arch or walls sometime after the ground has been exposed, due to loosening or to over-stress and "brittle" fracture (ground separates or breaks along distinct surfaces, opposed to squeezing ground). In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water, slow raveling above. Stiff fissured clays may be slow or fast raveling depending upon degree of overstress.
Squeezing	Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increase in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. The rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination of raveling at excavation surface and squeezing at depth behind surface.
Swelling	Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly pre-consolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite.
Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (approx. 30º -35º). When exposed at steeper slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Clean, dry angular materials.
Cohesive Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (approx. 30º -35º). When exposed at steeper slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Apparent cohesion in moist sand, or weak cementation in any granular soil, may allow the material to stand for a brief period of raveling before it breaks down and runs.

Ground Classification	Ground Behavior	Typical Soil Types
Flowing	A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and walls, and can flow for great distances, completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity. May also occur in highly sensitive clay when such material is disturbed.

It is our opinion that trenchless construction at the proposed location can be accomplished by an experienced contractor using bore and jack equipment. Provisions for controlling raveling and running sandy soils should be provided during the trenchless operation to minimize ground loss and ground subsidence.

It is the contractor's responsibility to design and select the appropriate bore and jack construction method, support system and to follow the requirements of the health and safety rules of the State of California pertaining to tunnel construction and permit requirements of the San Diego County, and other local agencies, if applicable.

10.4.2 Bore and Jack Construction Recommendations

Bore-and-jack is a trenchless construction method for installing pipes where open-cut technique is not feasible. This is a multi-stage process of construction which includes a temporary horizontal jacking platform and a starting alignment track in an entrance pit at a desired elevation. Manual control is used to jack the pipe at the starting point of the alignment with simultaneous excavation of the soil being accomplished by a rotating cutting head in the leading edge of the pipe's annular space.

The selection of trenchless pipe crossing methods and equipment depends on pipe material, length of crossing, and anticipated ground conditions, and should be made by the contractor. Bore-and-jack pipe construction operations involve the initial construction of a jacking/tunneling pit and a receiving pit at each end of the pipe segment to be jacked. Site-specific ground conditions and soil classifications pertaining to this project are presented in the following table.

Table No. 14, Site-Specific Ground Classifications

Boring No.	Boring Depth (Feet)	Soil Types Anticipated Near Casing Profile	Ground Classification Near Casing Profile
BH-01A	13.0	SP	Blows 50-6". Moisture 1 and 7 percent. No groundwater encountered.
BH-02	26.5	SM	Blows 6/7/9 and 4/9/12. Moisture 1 percent. No groundwater encountered.

Boring No.	Boring Depth (Feet)	Soil Types Anticipated Near Casing Profile	Ground Classification Near Casing Profile
BH-03	26.5	SM	Blows 4/9/8 and 5/7/8. Moisture 2 percent. No groundwater encountered.
BH-04	31.5	SM	Blows 7/13/15 and 7/9/12. Moisture 4 and 19 percent. No groundwater encountered.
BH-08	26.5	SP and SM	Blows 26/27/25 and 21/23/30. Moisture 1 and 3 percent. No groundwater encountered.
BH-09	31.5	SP	Blows 4750-2” and 50-6”. Moisture 2 and 6 percent. No groundwater encountered.
BH-10	25.5	SP-SM and SM	Blows 21/38/35 and 25/50-6”. Moisture 2 and 17 percent. No groundwater encountered.
BH-11	26.5	SP	Blows 28/35/32 and 22/50-5”. Moisture 1 and 2 percent. No groundwater encountered.

The working/access shafts are utilized to remove the spoil and to transport the construction materials and personnel for a bore-and-jack project. The vertical face of the working shaft may be shored with sheet piles and/or soldier piles and lagging. The face of the shaft also can be supported by ribs and laggings. The design of sheet piling, soldier beam and lagging system may be designed according to the recommendations provided in Section 10.3, *Shoring Design*. Frequent contact grouting may be necessary to reinforce the support during construction.

The total load that can be developed in the jacking plate would depend on the depth and area of the plate. The jacking equipment should not impose a reaction of more than the allowable net bearing pressure summarized in Table No. 10, *Jacking System Design Parameters* on the stabilized soils within the jacking pit.

Grouting through the pipe casing after jacking is recommended to fill any possible voids created by the jacking operation. Jacking operations should be performed in accordance with the Standard Specifications for Public Works Construction, Sections 306-2 and 306-3 (Public Works Standards, 2021). Contractors should maintain the standard grouting method so that no heave occurs.

Excavation procedures and shoring systems should be properly designed and implemented/installed to minimize the effect of settlement during construction. The contractor is responsible for minimizing impacts of crossing operations. Ground distress potential along a crossing alignment depends on a number of factors, including type of soils, type of face support, internal pressure maintained to support the face, length of unlined zone, if any, and the amount of gap between the shield and the surrounding soils. The potential of any significant ground distress at the surface can be minimized by selecting the proper equipment and construction method.

The zone of influence of properly performed pipe crossing should be limited to a distance of about 2D above the crown of the shield, where D is the diameter of the shield. When the depth of crown cover is about 2D or more, maximum ground surface settlement, if any, can be expected to be less than the thickness of the gap around the pipe. Higher ground settlement may occur for less depth of cover and inadequately supported pits can induce significant ground movement or even collapse.

It is the contractor's responsibility to document the existing pre-construction conditions of streets and any facilities and monitor deformations during construction. We recommend that the ground surface above crossing operations be continuously monitored during construction using a surface settlement monument to make sure any vertical and horizontal movements are within allowable limits. Corrective action will be required by the contractor if deformations exceed the allowable limits.

11.0 GEOTECHNICAL SERVICES DURING CONSTRUCTION

The project geotechnical consultant should review plans and specifications as the project design progresses. Such review is necessary to identify design elements, assumptions, or new conditions which require revisions or additions to our geotechnical recommendations.

The project geotechnical consultant should be present to observe conditions during construction. Testing should be performed to determine density and moisture of the during pipeline installation. Geotechnical observation and testing should be performed as needed to verify compliance with project specifications. Additional geotechnical recommendations may be required based on subsurface conditions encountered during construction.

12.0 CLOSURE

This report is prepared for the project described herein and is intended for use solely by Albert A. Webb Associates 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.

13.0 REFERENCES

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Appendix A

Field Exploration

APPENDIX A

FIELD EXPLORATION

Our field investigation included an alignment reconnaissance and a subsurface exploration program consisting of drilling soil borings and excavation of test pits. During the reconnaissance, the surface conditions were noted, and the borings and test pit locations were marked at locations reviewed and approved by Mr. Shane Bloomfield with Albert A. Webb Associates. The selected locations should be considered accurate only to the degree implied by the method used to locate them in the field.

Nineteen exploratory borings (BH-01 through BH-17, BH-01A and BH-06A) were drilled from July 10, 2023, to July 14, 2023, to investigate the subsurface conditions. The planned depths of the borings were between 15.0 and 30.0 feet below ground surface (bgs). The borings were drilled to the maximum depths between 3.5 and 31.5 feet bgs. Due to refusal on potential gravel, cobbles and boulder, some of the borings were terminated at shallower depths. The borings details are presented in the following tables.

Table No. A-1, Summary of Borings

Boring No.	Boring Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
BH-01	15.0	6.0	N/E	7/11/23
BH-01A	15.0	13.0	N/E	7/11/23
BH-02	25.0	26.5	N/E	7/14/23
BH-03	25.0	26.5	N/E	7/10/23
BH-04	30.0	31.5	N/E	7/12/23
BH-05	15.0	16.5	N/E	7/10/23
BH-06	15.0	3.5	N/E	07/10/23
BH-06A	15.0	15.5	N/E	07/10/23
BH-07	15.0	15.5	N/E	07/10/23
BH-08	15.0	26.5	N/E	07/10/23
BH-09	25.0	31.5	N/E	07/11/23
BH-10	30.0	25.5	N/E	07/12/23
BH-11	25.0	26.5	N/E	07/14/23
BH-12	15.0	16.5	N/E	07/11/23
BH-13	15.0	16.5	N/E	07/11/23
BH-14	15.0	16.5	N/E	07/11/23
BH-15	15.0	16.5	N/E	07/13/23

Boring No.	Boring Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
BH-16	15.0	16.3	N/E	07/13/23
BH-17	15.0	15.7	N/E	07/13/23

The borings were advanced using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers for soils sampling. Encountered materials were continuously logged by a Converse Engineer 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.

The exact depths at which material changes occur cannot always be established accurately. Unless a more precise depth can be established by other means, changes in material conditions that occur between drive samples are indicated on the logs at the top of the next drive sample.

Four exploratory test pits (TP-01 through TP-04) were excavated on August 3, 2023 using a backhoe equipped with 3 feet-wide bucket to investigate the subsurface conditions on April 21, 2022. The test pits were excavated between 10.0 feet and 10.4 feet below the existing ground surface (bgs). Photos 1 through 7 in appendix C depict the size of the excavated materials. The test pits details are presented in the following tables.

Table No. A-2 Summary of Test Pits

Test Pit No.	Test Pit Depth (ft., bgs)		Groundwater Depth (ft., bgs)	Date Completed
	Proposed	Completed		
TP-01	10.0	10.3	N/E	08/03/23
TP-02	10.0	10.0	N/E	08/03/23
TP-03	10.0	10.3	N/E	08/03/23
TP-04	10.0	10.4	N/E	08/03/23

During exploration, 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.

Following the completion of logging and sampling, the borings were backfilled with soil cuttings, and then compacted by pushing down with augers using drill rig weight. Following the completion of test pits, they were backfilled in lifts with excavated soil, tamped, and then wheel rolled at the surface using the bucket under the weight of the backhoe. 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 and test pits, refer to Drawing Nos. A-1a and A-1b, *Unified Soil Classification and Key to Boring Logs and Test Pits Symbols*. For logs of borings and test pits, see Drawings No. A-2 through A-24, *Log of Borings*. Elevation used in boring logs are based on above mean sea level (amsl).

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	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
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	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
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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)
- **UW** Unit Weight (ASTM D 2937)
- **WA** Passing No. 200 Sieve

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

DRILLING METHOD SYMBOLS

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

UNIFIED SOIL/BEROCK CLASSIFICATION AND KEY TO BORING LOG AND TEST PIT SYMBOLS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. 21-81-260-02

Drawing No. A-1a

Project ID: 21-81-260-02.GPJ;Template: KEY

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/BEROCK CLASSIFICATION AND KEY TO BORING LOG AND TEST PIT SYMBOLS

Log of Boring No. BH-01

Date Drilled: 7/11/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -132 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
		ALLUVIUM: **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 2.0" maximum dimension, very dense, dry, brown.			27/40/40	1		*disturbed
5					50-6"			*no recovery
		End of boring at 6.0' below ground surface due to refusal. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/11/2023.						

Log of Boring No. BH-01A

Date Drilled: 7/11/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -132 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
		ALLUVIUM: **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 2.0" maximum dimension, dense, dry, brown.						PA, SE *no recovery
5		**SAND WITH GRAVEL (SP):** fine to coarse-grained, gravel up to 2.0" maximum dimension, dense, dry, brown.			24/25/28			*disturbed
		very dense			50-6"			*no recovery
10		- at 10.0': cobble/gravel aggregate.			50-6"	1		
					50-6"	7		*disturbed

End of boring at 13.0' below ground surface due to refusal.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/11/2023.

Log of Boring No. BH-02

Date Drilled: 7/14/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -137 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
0	**ALLUVIUM:** **SILTY SAND (SM):** few gravel up to 2.0" maximum dimension, dense, dry, brown.		X				CP
2		X	X	8/12/24	1		*disturbed
5	dense, moist.	X		12/17/29	9	107	
7	medium dense, dry.	X		6/7/9	1		CR, *disturbed
10		X		4/9/12	1	107	DS, *disturbed
15		X		6/16/17	1		*disturbed
20	very dense, dry.	X		19/21/33	1	129	
25	**CLAYEY SAND (SC):** fine to coarse grained, dense, moist, brown.	X		13/19/28	29	92	

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.

End of boring at 26.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/14/2023.

Log of Boring No. BH-03

Date Drilled: 7/10/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -132 Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Description	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**3 INCHES ASPHALT CONCRETE / NO AGGREGATE BASE**		X				PA, SE
	ALLUVIUM: **SILTY SAND (SM):** fine to medium-grained, medium dense, moist, gray.	X	X	5/6/6	3	90	
5		X		9/10/11	2	94	
		X		4/9/8	2	94	
10		X		5/7/8	1		*disturbed
15	**SAND (SP):** fine to coarse-grained, brown.	X		4/18/32	1		*disturbed
20	**SANDY SILT (ML):** fine-grained sand, very dense, olive.	X		20/31/38	5	115	
25		X		10/15/23	10	113	

End of boring at 26.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.

Log of Boring No. BH-04

Date Drilled: 7/12/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -128 Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Description	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**ALLUVIUM:** **SILTY SAND (SM):** fine to coarse-grained, medium dense, moist, brown.		X (0–5)				CP
2		X		11/14/15	3	101	
5		X		8/8/12	18	97	
7		X		7/13/15	19	107	
10		X		7/9/12	4	98	CR
15		X		8/9/22	8	95	
20		X		11/13/18	7	103	
25		X		10/14/17	14	79	
30		X		18/19/23	9	91	

End of boring at 31.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/12/2023.

Log of Boring No. BH-05

Date Drilled: 7/10/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -197 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
		ALLUVIUM: **SILTY SAND (SM):** fine to coarse-grained, scattered gravel up to 0.5" in maximum dimension, medium dense, dry, gray.						PA,SE
					3/4/7	1		*disturbed
5		dense, moist.			5/7/13	3	90	
					10/13/13	1	99	DS
10					6/10/12	3	86	
15					10/19/25	5	103	
		End of boring at 16.5' below ground surface. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.						

Log of Boring No. BH-06

Date Drilled: 7/10/2023 | Logged by: Tony Maciel | Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA | Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -160 | 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
		ALLUVIUM: **SAND (SP):** fine to coarse-grained, cobbles up to 5.0" maximum dimension, very dense, gray.			40/50-6"			*no recovery
		End of boring at 3.5' below ground surface due to refusal. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.						

Log of Boring No. BH-06A

Date Drilled: 7/10/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -161 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
0–5		**ALLUVIUM:** **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 2.0" maximum dimension, very dense, moist, gray.						CP, CR
					20/33/50			
5		**SAND WITH GRAVEL (SP):** gravel up to 2.0" maximum dimension, very dense, moist, gray.			24/44/50			
					50-6"			*no recovery
10					40/50-6"			
15					50-6"			*no recovery
		End of boring at 15.5' below ground surface. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.						

Log of Boring No. BH-07

Date Drilled: 7/10/2023 | Logged by: Tony Maciel | Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA | Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -138 | Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Summary of Subsurface Conditions	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0–5	**ALLUVIUM:** **SAND WITH SILT AND GRAVEL (SP-SM):** fine to medium-grained, some gravel up to 2.5" maximum dimension, very dense, moist, brown.		X (0–5)				PA,SE
~2–3.5		X		9/23/40	4	123	
5	**SILTY SAND (SM):** fine to medium-grained, some gravel up to 2.5" maximum dimension, very dense, moist, brown.	X		25/29/40	2	105	
~7		X		22/38/40	1	103	
10		X		37/40/42	1		*disturbed
15		X		50-6"	2		*disturbed

End of boring at 15.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.

Log of Boring No. BH-08

Date Drilled: 7/10/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -95 Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Summary of Subsurface Conditions	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**5.5 INCHES ASPHALT CONCRETE / 6.5 INCH AGGREGATE BASE**		X				
	ALLUVIUM: **SILTY SAND (SM):** fine to coarse-grained, some gravel up to 2.0" maximum dimension, very dense, dry, brown.	X	X	20/40/50	1		*disturbed
5		X		23/20/21	1		*disturbed
		X		26/27/25			
10	moist.	X		21/23/30	3	106	DS
15	dry.	X		18/50-6"	1		*disturbed
20	moist.	X		50-6"	7	106	
25		X		20/35/50	6	106	

End of boring at 26.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/10/2023.

Log of Boring No. BH-09

Date Drilled: 7/11/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -99 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
		ALLUVIUM: **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 1.5" in maxiumum dimension, very dense, moist, brown.						PA, SE
					50-5"			*no recovery
5					50-4"			*no recovery
					47/50-2"	6	125	
10					50-6"			*no recovery
15					45/50-6"	2	114	
20					30/30/46	2	113	
25					33/40/50-5"	3	113	
30					28/33/50	5	112	
		End of boring at 31.5' below ground surface. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/12/2023.						

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. 21-81-260-02 Drawing No. A-12

Log of Boring No. BH-10

Date Drilled: 7/12/2023 | Logged by: Tony Maciel | Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA | Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -80 | Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Summary of Subsurface Conditions	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**ALLUVIUM:** **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 3.0" maximum dimension, very dense, moist, brown.		X (0–5)				CP
2		X		30/50-5"	2	95	
5		X		50-6"			*no recovery
7		X		21/38/35	2	108	
10	**CLAYEY SAND (SC):** fine to coarse grained, gravel up to 3.0" maximum dimension, very dense, moist,.	X		25/50-6"	17	96	CR
15		X		17/27/41	21	91	
20	**SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 3.0" maximum dimension, very dense, moist, brown.	X		40/50-5"	2	114	
25		X		50-6"			*no recovery

End of boring at 25.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/12/2023.

Log of Boring No. BH-11

Date Drilled: 7/14/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -80 Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Summary	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**ALLUVIUM:** **SAND WITH SILT AND GRAVEL (SP-SM):** fine to coarse-grained, gravel up to 2" in maximum dimension, very dense, moist, brown.		X (0–5)				PA, SE
2		X		37/50-4"	1	136	
5		X		23/43/35	2	105	
7		X		28/35/32	1	111	
10		X		22/50-5"	1	112	
15		X		21/31/42	2		*disturbed
20		X		39/50-6"	2	98	
25		X		34/43/46	1	115	

End of boring at 26.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/14/2023.

Log of Boring No. BH-12

Date Drilled: 7/11/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -56 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
0		**ALLUVIUM:** **SANDY SILT (ML):** fine to coarse-grained sand, dense, moist, gray.		X				PA, SE
2			X	X	12/17/17	5	107	
5		**CLAYEY SAND (SC):** fine to medium-grained, dense, moist, dark brown.	X		10/20/25	17	115	
7			X		12/18/30	16	108	
10			X		16/32/30	18	111	
15			X		13/25/35	9	121	

End of boring at 16.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/14/2023.

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. 21-81-260-02

Drawing No. A-15

Log of Boring No. BH-13

Date Drilled: 7/11/2023 | Logged by: Tony Maciel | Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA | Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -79 | 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
0		**1.5 INCHES ASPHALT CONCRETE / NO AGGREGATE BASE**						CP, CR
		ALLUVIUM: **CLAYEY SAND (SC):** fine to coarse-grained, very dense, moist, reddish-brown.						
					13/29/40	17	99	
5					14/26/36	19	86	
					16/26/40	20	120	DS
10					15/24/33	21	107	
15					14/27/40	23	96	
		End of boring at 16.5' below ground surface. No groundwater encountered. Borehole backfilled with soil cuttings, compacted with an auger, and patched with asphalt concrete on 7/11/2023.						

Log of Boring No. BH-14

Date Drilled: 7/11/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 6 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
		ALLUVIUM: **SILTY SAND WITH GRAVEL (SM):** fine to coarse-grained, gravel up to 2.0" maximum dimension, dense, moist, brown.						PA, SE
					14/15/16			*no recovery
5					10/21/25	5	108	
					20/27/35	6	95	
10					17/25/44	12	118	
15		**CLAYEY SAND (SC):** fine to coarse grained, gravel up to 2.0" maximum dimension, dense, moist, brown.			18/13/23	27	92	

End of boring at 16.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/11/2023.

Log of Boring No. BH-15

Date Drilled: 7/13/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -144 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
0		**ALLUVIUM:** **SILTY SAND WITH GRAVEL (SM):** fine to coarse-grained, gravel up to 2.5" maximum dimension, dense, moist, brown.		X				PA, SE
2				X	32/20/20			*no recovery
5					25/30/40			*no recovery
7		dry.	X		15/32/50	1	107	
10		moist.	X		5/8/12	8		*disturbed
15			X		40/40/30	1	112	

End of boring at 16.5' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/13/2023.

Log of Boring No. BH-16

Date Drilled: 7/13/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -134 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
0		**ALLUVIUM:** **SILTY SAND WITH GRAVEL (SM):** fine to coarse-grained, gravel up to 2.5" maximum dimension, dense, moist, brown.		X				CP
			X	X	25/17/24	10	85	
5			X		30/30/42	1	95	DS
			X		16/24/38	9	79	CR
10			X		12/12/22	6	83	
15			X		32/35/50-4"	5	85	
		End of boring at 16.3' below ground surface. No groundwater encountered. Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/13/2023.						

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **A-19**

Log of Boring No. BH-17

Date Drilled: 7/13/2023 Logged by: Tony Maciel Checked By: Hashmi Quazi

Equipment: CME 75/ 8" HSA Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): -135 Depth to Water (ft, bgs): NOT ENCOUNTERED

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.

Depth (ft)	Description	Samples: Drive	Samples: Bulk	Blows	Moisture (%)	Dry Unit Wt. (pcf)	Other
0	**ALLUVIUM:** **SILTY SAND WITH GRAVEL (SM):** fine to coarse-grained, gravel up to 2.75" maximum dimension, very dense, moist, brown.		X (0–5)				PA, SE
2		X		32/28/26	2	93	
5		X		28/32/44	6	88	
7		X		20/24/38	1	99	
10		X		10/12/22	3	84	
15		X		20/50-3"	2	92	

End of boring at 15.7' below ground surface.
No groundwater encountered.
Borehole backfilled with soil cuttings and then compacted by pushing down with augers using drill rig weight on 7/13/2023.

Log of Test Pit No. TP-01

Dates Drilled: 8/3/2023 | Logged by: Stephen McPherson | Checked By: Hashmi Quazi

Equipment: Backhoe with 3' bucket | Driving Weight and Drop: N/A

Ground Surface Elevation (ft): -129 | 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 Test Pit 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
		NO ASPHALT CONCRETE / 6" AGGREGATE BASE						
5		**ALLUVIUM:** **SILTY SAND WITH GRAVEL (SM):** fine to coarse-grained, little to some gravel up to 3 inches maximum dimension and cobble up to 12 inches maximum dimension, scattered boulders up to 24 inches maximum dimension, moist, grayish brown.						
10		**GRAVEL AND COBBLES (GP):** mostly gravel up to 2 inches maximum dimension and cobble up to 12 inches maximum dimension, scattered boulders up to 24 inches maximum dimension, few silt and sand, moist, grayish brown.						
		End of test pit at 10.3 feet below ground surface. No groundwater encountered. Backfill using soil cuttings and tamped with backhoe weight on 8/3/2023.						

Log of Test Pit No. TP-02

Dates Drilled: 8/3/2023 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: Backhoe with 3' bucket Driving Weight and Drop: N/A

Ground Surface Elevation (ft): -170 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 Test Pit 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
		ALLUVIUM: **SAND WITH SILT (SW-SM):** few gravel and cobble up to 8 inches maximum dimension, scattered boulders up to 18 inches maximum dimension, caliche, moist, grayish brown. - @ 3.0': abandoned PVC pipe going east and west.		X				
5		**SILTY SAND WITH GRAVEL AND COBBLES (SM):** fine to coarse-grained, little to some gravel and cobbles up to 12 inches maximum dimension, scattered boulders up to 24 inches maximum dimension, moist, grayish brown.		X				
10		**SAND WITH SILT (SW-SM):** few gravel and cobble up to 6 inches maximum dimension, moist, brown.		X				
		End of test pit at 10.0 feet below ground surface. No groundwater encountered. Backfill using soil cuttings and tamped with backhoe weight on 8/3/2023.						

Log of Test Pit No. TP-03

Dates Drilled: 8/3/2023 Logged by: Stephen McPherson Checked By: Hashmi Quazi

Equipment: Backhoe with 3' bucket Driving Weight and Drop: N/A

Ground Surface Elevation (ft): -140 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 Test Pit 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 10		**ALLUVIUM:** **SILTY SAND WITH GRAVEL AND COBBLES (SM):** fine to coarse-grained, little to some gravel and cobbles up to 12 inches maximum dimension, scattered boulders up to 18 inches maximum dimension, roots and rootlets, moist, grayish brown.		X				
		End of test pit at 10.3 feet below ground surface. No groundwater encountered. Backfill using soil cuttings and tamped with backhoe weight on 8/3/2023.						

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

Project No. 21-81-260-02

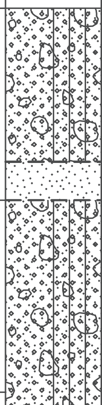
Drawing No. A-23

Log of Test Pit No. TP-04

Dates Drilled: 8/3/2023 | Logged by: Stephen McPherson | Checked By: Hashmi Quazi

Equipment: Backhoe with 3' bucket | Driving Weight and Drop: N/A

Ground Surface Elevation (ft): -137 | 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 Test Pit 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
		ALLUVIUM: **SAND WITH SILT (SW-SM):** fine to coarse-grained, few gravel up to 3 inches maximum dimension, few cobble up to 12 inches maximum dimension, scattered boulders up to 36 inches maximum dimension, roots and rootlets, moist, grayish brown.		X				
5		**SAND (SP):** fine to coarse-grained, roots and rootlets, moist, dark brown.						
10		**SAND WITH SILT (SW-SM):** fine to coarse-grained, few gravel and cobbles up to 12 inches maximum dimension, scattered boulders up to 36 inches maximum dimension, roots and rootlets, moist, grayish brown.						

End of test pit at 10.4 feet below ground surface.
No groundwater encountered.
Backfill using soil cuttings and tamped with backhoe weight on 8/3/2023.

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California

Project No. **21-81-260-02** | Drawing No. **A-24**

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 test method. This test is used in soil classification and provides qualitative information on strength and compressibility characteristics of soils at the location tested. For test results, see the Logs of Borings in Appendix A, *Field Exploration*.

Sand Equivalent (SE)

Ten 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.	Depth (feet)	Soil Description	Sand Equivalent
BH-01A	0-5	Sand with Silt and Gravel (SP-SM)	39
BH-03	0-5	Silty Sand (SM)	15
BH-05	0-5	Silty Sand (SM)	50
BH-07	0-5	Sand with Silt and Gravel (SP-SM)	32
BH-09	0-5	Sand with Silt and Gravel (SP-SM)	33
BH-11	0-5	Sand with Silt and Gravel (SP-SM)	53
BH-12	0-5	Sandy Silt (ML)	2
BH-14	0-5	Silty Sand with Gravel (SM)	5
BH-15	0-5	Silty Sand with Gravel (SM)	47
BH-17	0-5	Silty Sand with Gravel (SM)	24

Soil Corrosivity Test (CR)

Seven 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 the soils when placed in contact with common construction materials. These tests were performed by AP Engineering and Testing, Inc. (Pomona, CA) Laboratory in accordance with California Tests CT643, 422, and 417. Test results are presented in the table below.

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

Boring No.	Depth (feet)	pH	Chloride (ppm)	Sulfate (ppm)	Minimum Electrical Resistivity (ohm-cm)
BH-02	7	9.3	52	42	4,416
BH-04	10	8.9	52	59	4,239
BH-06A	0-5	9.2	32	84	5,209
BH-09	7	9.4	25	55	4,780
BH-10	10	9.8	18	20	5,564
BH-13	0-5	8.9	1287	2023	207
BH-16	7	8.5	597	150	773

Grain-Size Analyses (PA)

To assist in classification of soils, mechanical grain-size analyses were performed on ten select samples in accordance with the ASTM Standard D6913 test method. Grain-size curves are shown in Drawing No. B-1a and B-2a, *Grain Size Distribution Results* and are presented in the following table.

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

Boring No.	Depth (ft)	Soil Classification	% Gravel	% Sand	%Silt	%Clay
BH-01A	0-5	Sand with Silt and Gravel (SP-SM)	35.0	54.2	10.8	
BH-03	0-5	Silty Sand (SM)	1.0	55.8	43.2	
BH-05	0-5	Silty Sand (SM)	1.0	74.8	24.2	
BH-07	0-5	Sand with Silt and Gravel (SP-SM)	29.0	62.8	8.2	
BH-09	0-5	Sand with Silt and Gravel (SP-SM)	27.0	64.2	8.2	
BH-11	0-5	Sand with Silt and Gravel (SP-SM)	31.0	59.9	9.1	
BH-12	0-5	Sandy Silt (ML)	0.0	11.9	88.1	
BH-14	0-5	Silty Sand with Gravel (SM)	26.0	44.3	29.7	
BH-15	0-5	Silty Sand with Gravel (SM)	34.0	37.5	28.5	
BH-17	0-5	Silty Sand with Gravel (SM)	21.0	63.8	15.2	

Maximum Density and Optimum Moisture Content (CP)

Laboratory maximum dry density-optimum moisture content relationship tests were performed on six representative bulk soil samples in accordance with the ASTM Standard D1557 test method. The test results are presented in Drawing No. 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.	Depth (feet)	Soil Description	Optimum Moisture (%)	Maximum Dry Density (pcf)
BH-02	0-5	Silty Sand (SM), Brown	8.5	124.0
BH-04	0-5	Silty Sand (SM), Brown	8.5	122.0
BH-06A	0-5	Sand with Silt and Gravel (SP-SM), Gray	6.0	130.0
BH-10	0-5	Sand with Silt and Gravel (SP-SM), Brown	8.0	119.0
BH-13	0-5	Clayey Sand (SC), Reddish Brown	17.0	115.0
BH-16	0-5	Silty Sand with Gravel (SM), Brown	15.0	116.0

Direct Shear (DS)

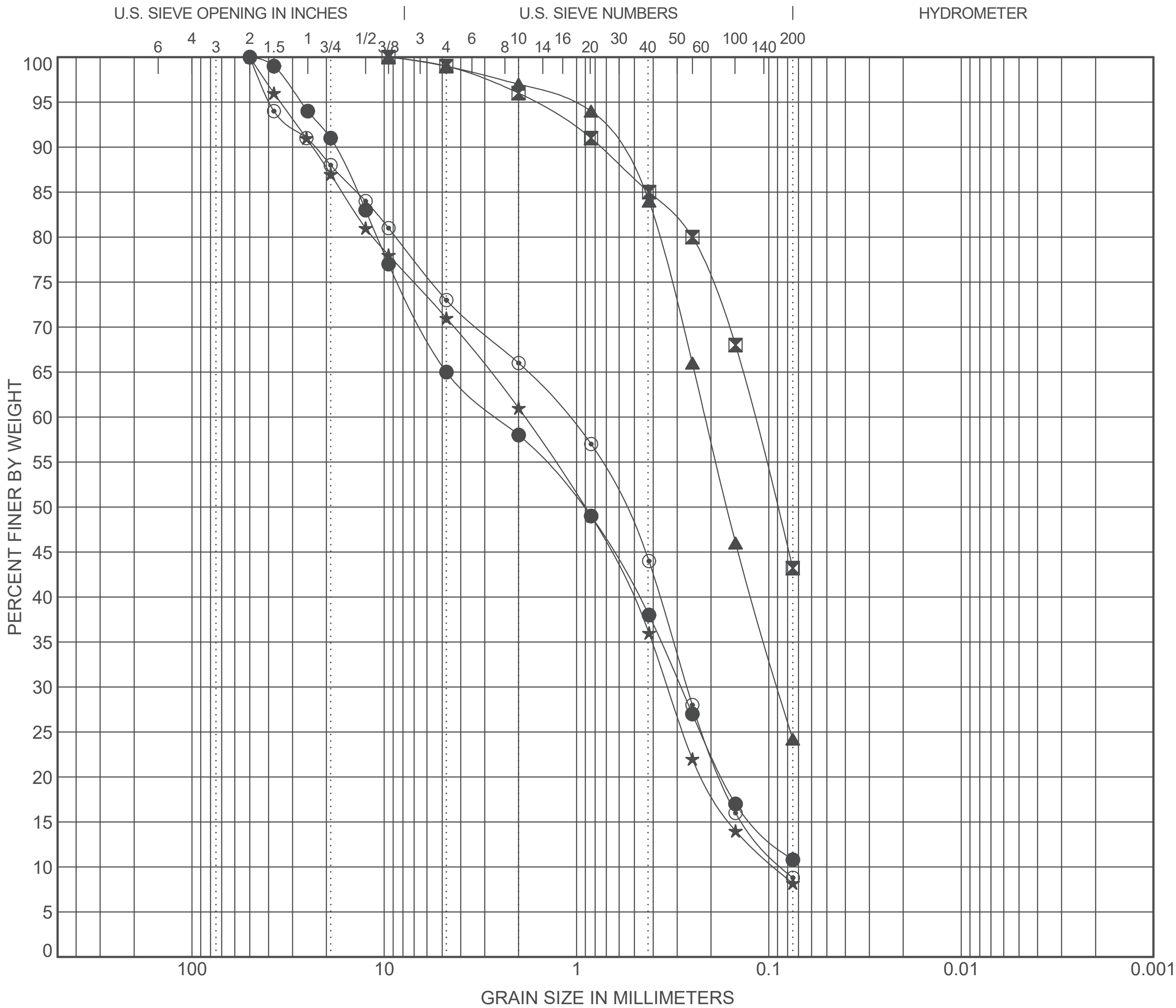
Five direct shear tests were performed on relatively undisturbed representative ring samples under soaked moisture condition in accordance with the ASTM D3080 procedure. For each test, three samples contained in brass sampler rings were placed, one at a time, directly into the test apparatus and subjected 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 data, including sample density and moisture content, see Drawings No. B-3 through B-7*, Direct Shear Test Results,* and the following table.

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

Boring No.	Depth (feet)	Soil Description	Ultimate Strength Parameters	
			Friction Angle (degrees)	Cohesion (psf)
BH-02	10.0-11.5	Silty Sand (SM)	31	50
BH-05	7.0-8.5	Silty Sand (SM)	35	40
BH-08	10.0-11.5	Silty Sand (SM)	31	100
BH-13	7.0-8.5	Clayey Sand (SC)	34	490
BH-16	5.0-6.5	Silty Sand with Gravel (SM)	31	10

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-01A**	**0-5**	**Sand with Silt and Gravel (SP-SM)**				**0.47**	**37.31**
⊠	**BH-03**	**0-5**	**Silty Sand (SM)**					
▲	**BH-05**	**0-5**	**Silty Sand (SM)**					
★	**BH-07**	**0-5**	**Sand with Silt and Gravel (SP-SM)**				**0.65**	**20.05**
⊙	**BH-09**	**0-5**	**Sand with Silt and Gravel (SP-SM)**				**0.75**	**13.34**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-01A**	**0-5**	**50**	**2.561**	**0.288**		**35.0**	**54.2**	**10.8**	
⊠	**BH-03**	**0-5**	**9.5**	**0.119**			**1.0**	**55.8**	**43.2**	
▲	**BH-05**	**0-5**	**9.5**	**0.214**	**0.09**		**1.0**	**74.8**	**24.2**	
★	**BH-07**	**0-5**	**50**	**1.861**	**0.336**	**0.093**	**29.0**	**62.8**	**8.2**	
⊙	**BH-09**	**0-5**	**50**	**1.122**	**0.267**	**0.084**	**27.0**	**64.2**	**8.8**	

GRAIN SIZE DISTRIBUTION RESULTS

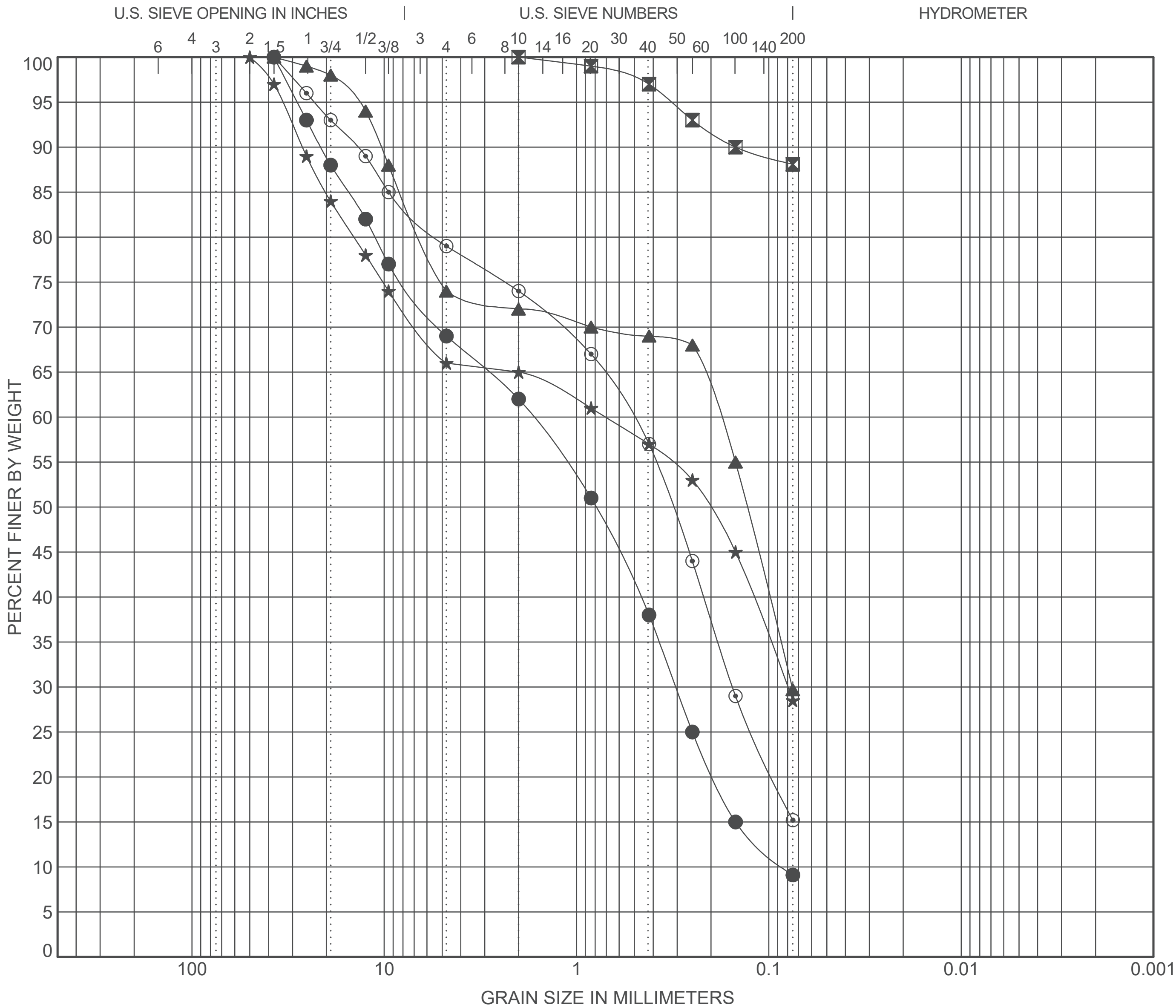
Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No.
21-81-260-02

Drawing No.
B-1a

Project ID: 21-81-260-02.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-11**	**0-5**	**Sand with Silt and Gravel (SP-SM)**				**0.65**	**20.51**
⊠	**BH-12**	**0-5**	**Sandy Silt (ML)**					
▲	**BH-14**	**0-5**	**Silty Sand with Gravel (SM)**					
★	**BH-15**	**0-5**	**Silty Sand with Gravel (SM)**					
⊙	**BH-17**	**0-5**	**Silty Sand with Gravel (SM)**					

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-11**	**0-5**	**37.5**	**1.708**	**0.305**	**0.083**	**31.0**	**59.9**	**9.1**	
⊠	**BH-12**	**0-5**	**2**				**0.0**	**11.9**	**88.1**	
▲	**BH-14**	**0-5**	**37.5**	**0.182**	**0.076**		**26.0**	**44.3**	**29.7**	
★	**BH-15**	**0-5**	**50**	**0.706**	**0.08**		**34.0**	**37.5**	**28.5**	
⊙	**BH-17**	**0-5**	**37.5**	**0.517**	**0.154**		**21.0**	**63.8**	**15.2**	

GRAIN SIZE DISTRIBUTION RESULTS

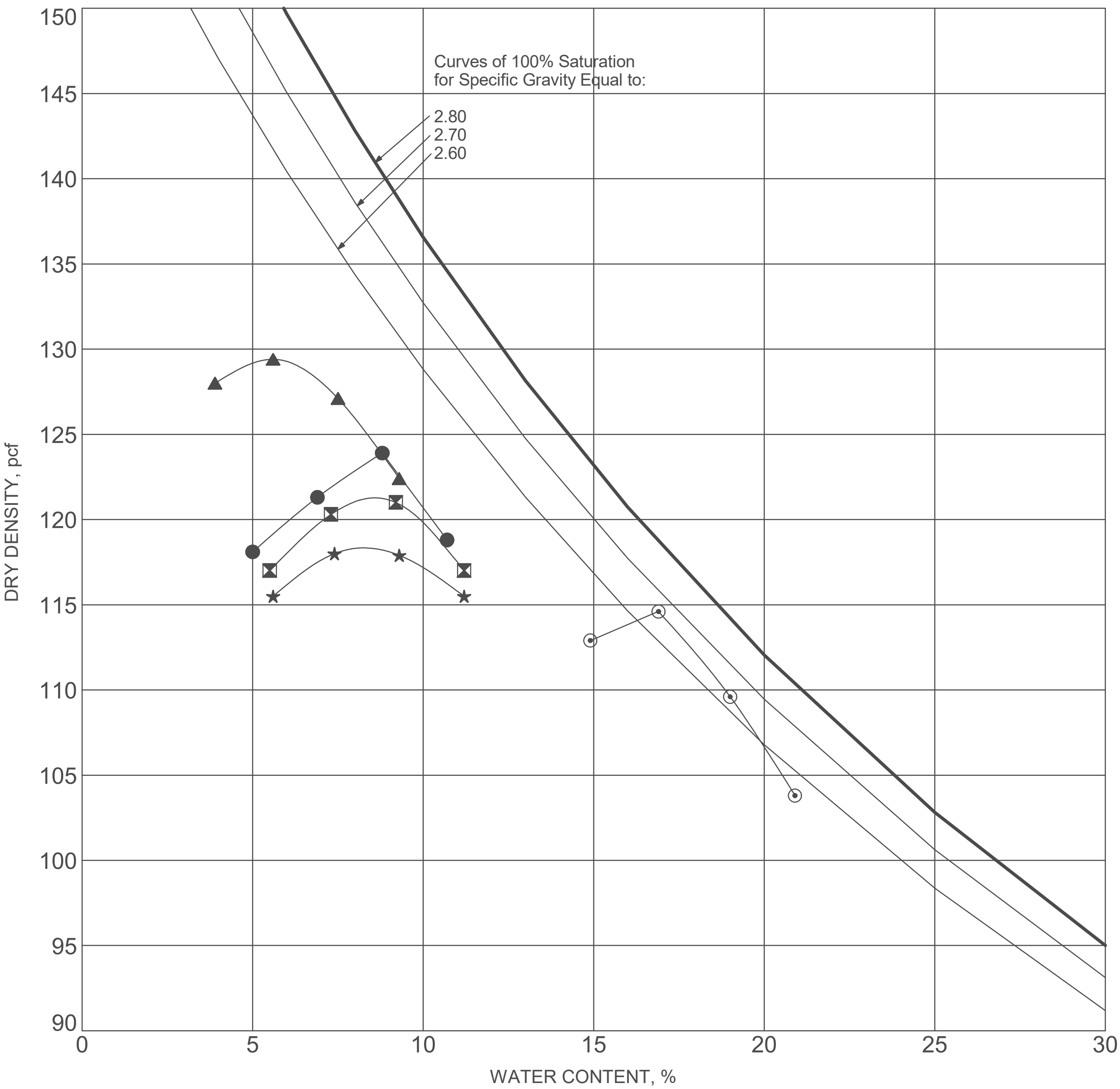
Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-2b**

Project ID: 21-81-260-02.GPJ; Template: GRAIN SIZE



SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	BH-02	0-5	Silty Sand (SM), Brown	D1557 Method B	8.5	124.0
⧗	BH-04	0-5	Silty Sand (SM), Brown	D1557 Method A	8.5	122.0
▲	BH-06A	0-5	Sand with Silt and Gravel (SP-SM), Gray	D1557 Method C	6.0	130.0
★	BH-10	0-5	Sand with Silt and Gravel (SP-SM), Brown	D1557 Method B	8.0	119.0
⊙	BH-13	0-5	Clayey Sand (SC), Reddish Brown	D1557 Method A	17.0	115.0

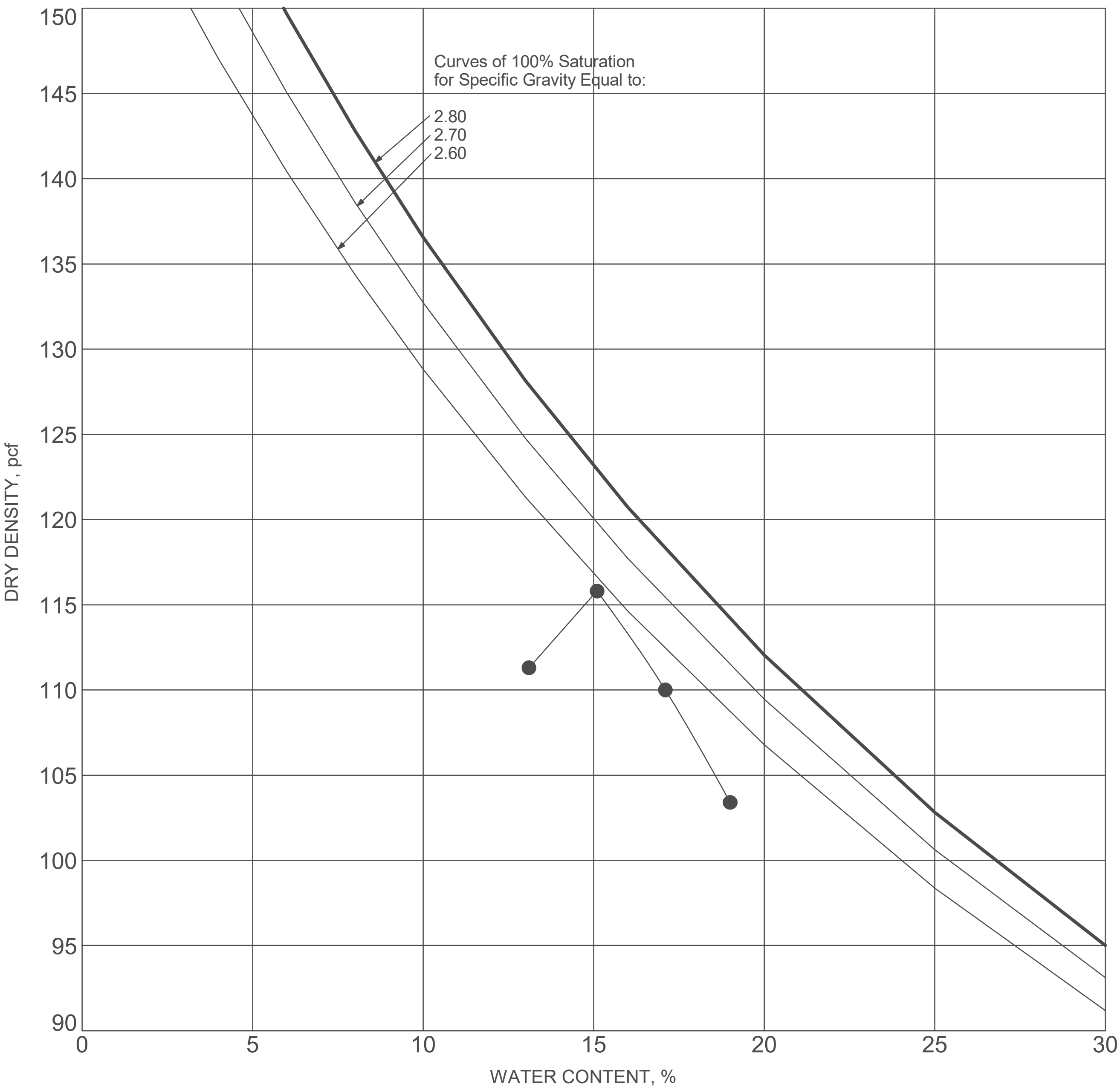
MOISTURE-DENSITY RELATIONSHIP RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. 21-81-260-02

Drawing No. B-2a



SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	**BH-16**	**0-5**	**Silty Sand with Gravel (SM), Brown**	**D1557 Method A**	**15.0**	**116.0**

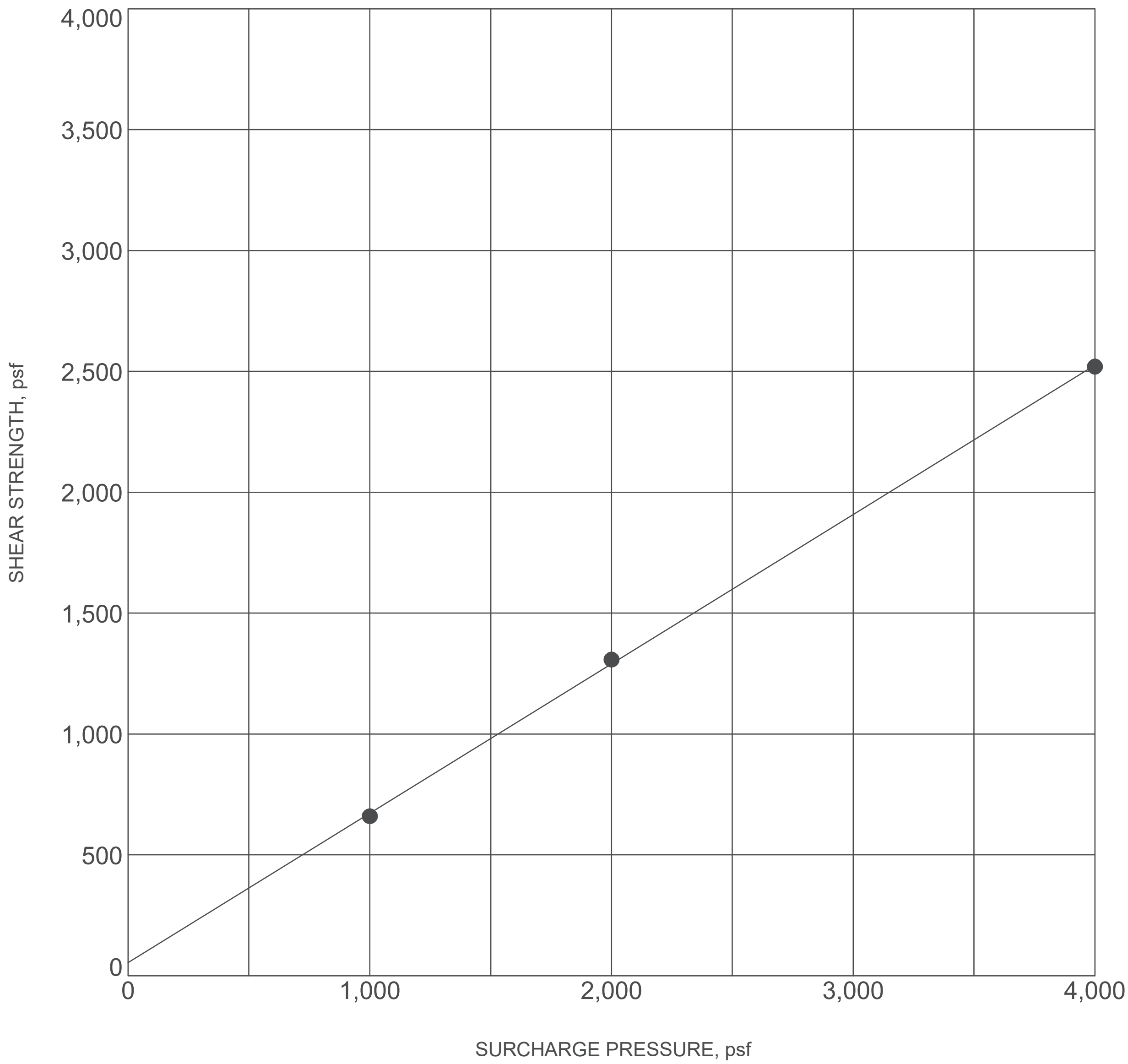
MOISTURE-DENSITY RELATIONSHIP RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No.
21-81-260-02

Drawing No.
B-2b



BORING NO. :	**BH-02**	DEPTH (ft) :	**10.0-11.5**
DESCRIPTION :	**Silty Sand (SM)**		
COHESION (psf) :	**50**	FRICTION ANGLE (degrees):	**31**
MOISTURE CONTENT (%) :	**1.0**	DRY DENSITY (pcf) :	**107**

NOTE: Ultimate Strength.

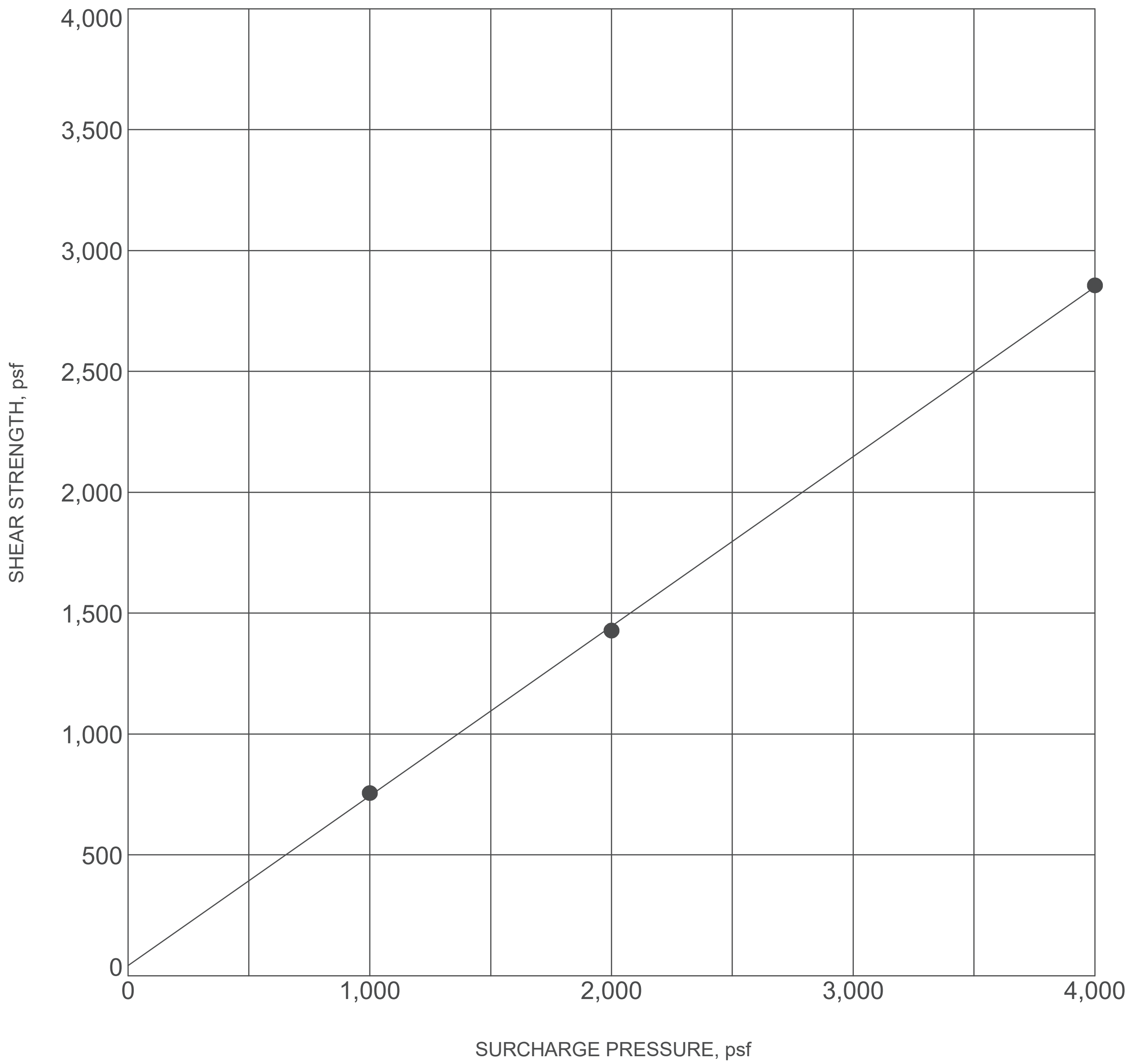
DIRECT SHEAR TEST RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-3**



BORING NO. :	**BH-05**	DEPTH (ft) :	**7.0-8.5**
DESCRIPTION :	**Silty Sand (SM)**		
COHESION (psf) :	**40**	FRICTION ANGLE (degrees):	**35**
MOISTURE CONTENT (%) :	**1.0**	DRY DENSITY (pcf) :	**99**

NOTE: Ultimate Strength.

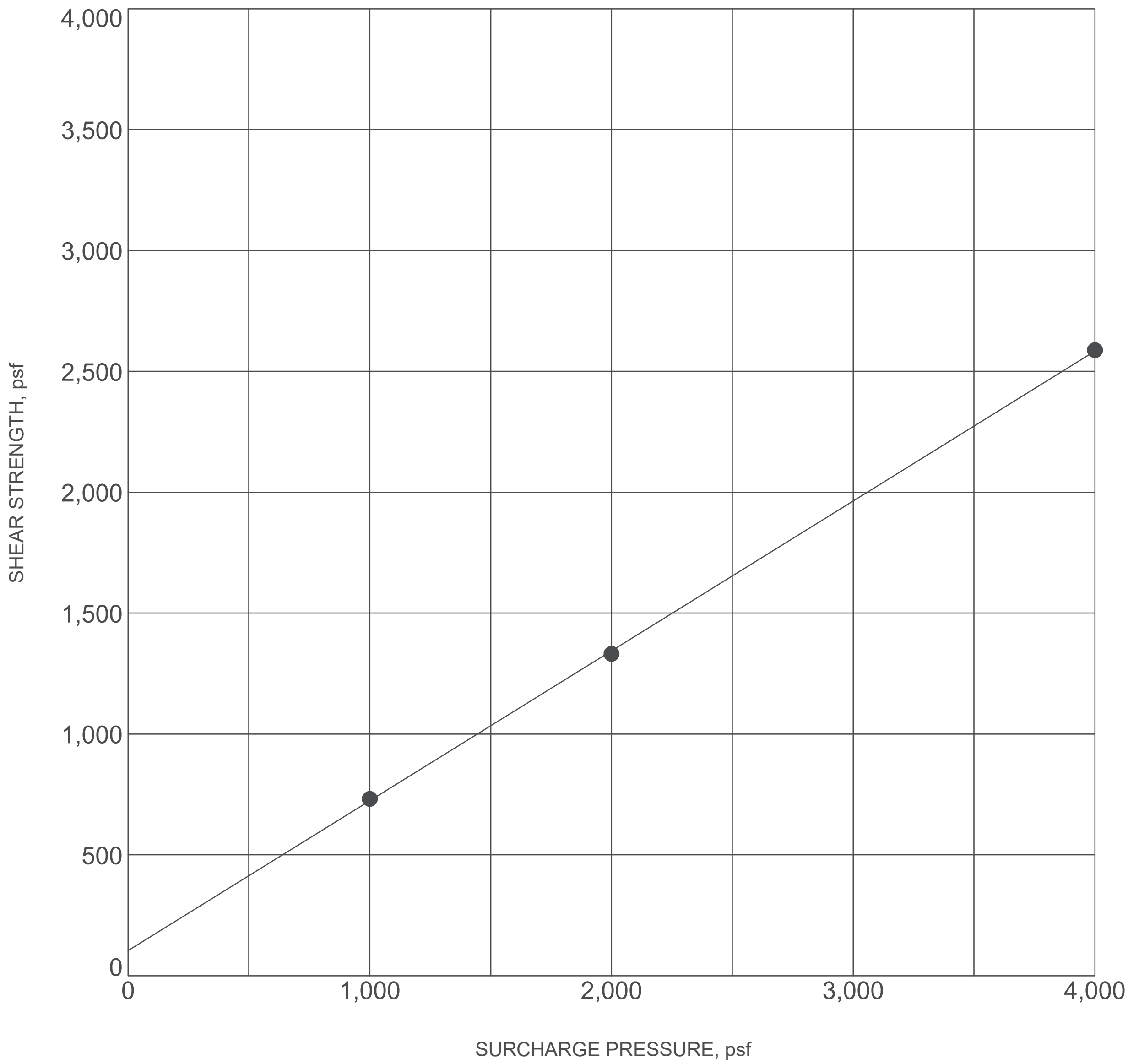
DIRECT SHEAR TEST RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-4**



BORING NO. :	**BH-08**	DEPTH (ft) :	**10.0-11.5**
DESCRIPTION :	**Silty Sand (SM)**		
COHESION (psf) :	**100**	FRICTION ANGLE (degrees):	**31**
MOISTURE CONTENT (%) :	**3.0**	DRY DENSITY (pcf) :	**106**

NOTE: Ultimate Strength.

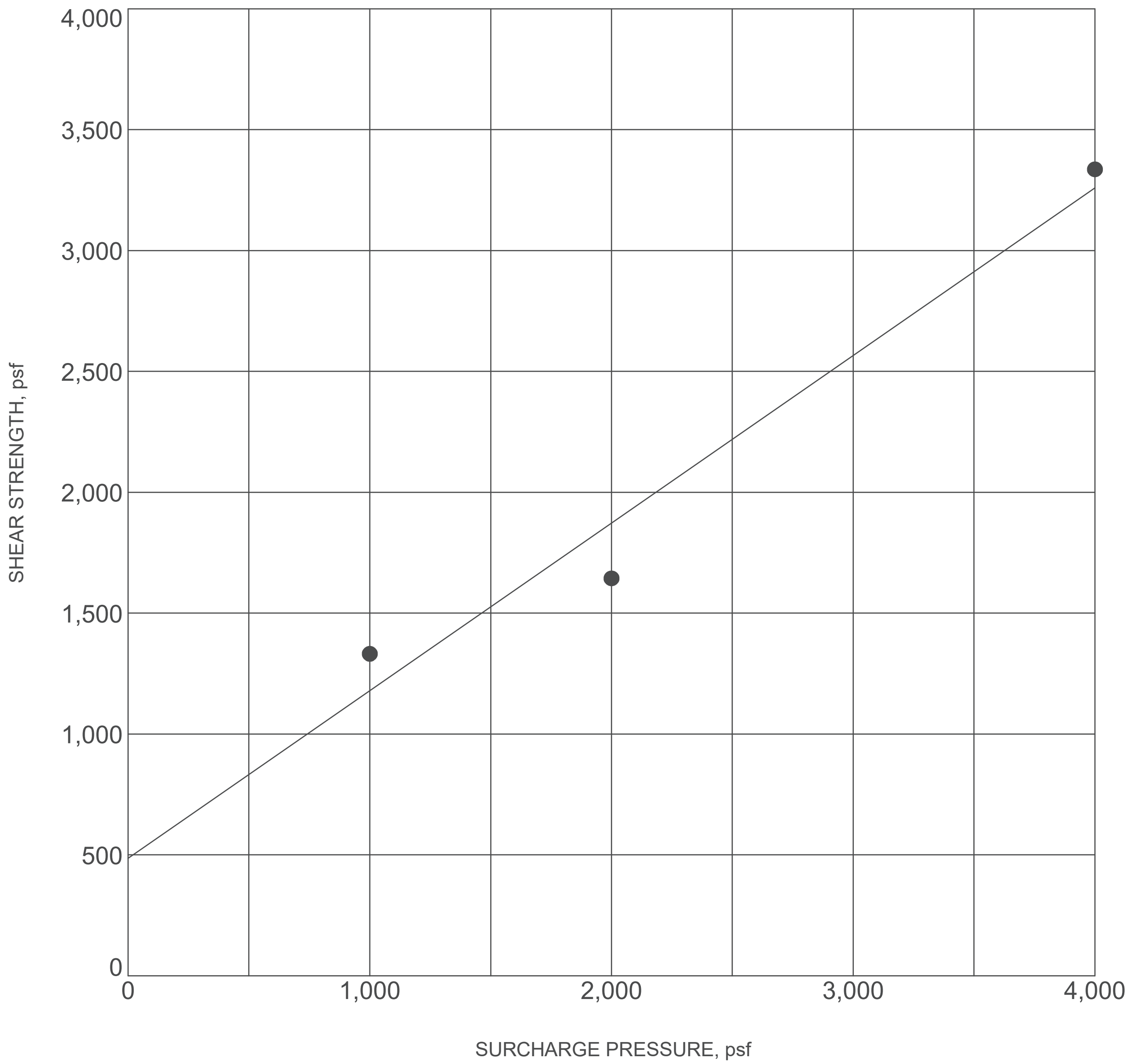
DIRECT SHEAR TEST RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-5**



BORING NO. :	**BH-13**	DEPTH (ft) :	**7.0-8.5**
DESCRIPTION :	**Clayey Sand (SC)**		
COHESION (psf) :	**490**	FRICTION ANGLE (degrees):	**34**
MOISTURE CONTENT (%) :	**20**	DRY DENSITY (pcf) :	**120**

NOTE: Ultimate Strength.

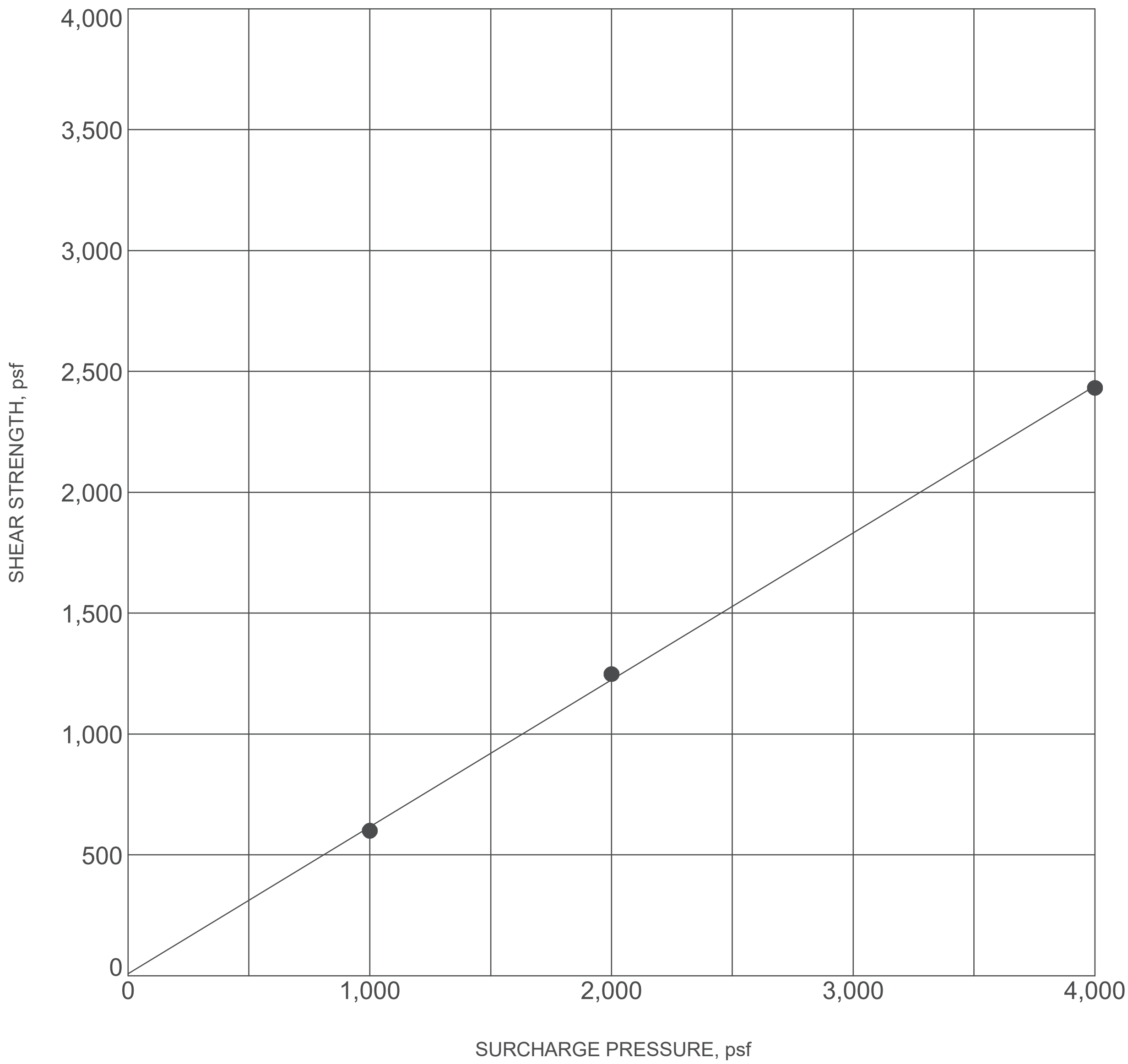
DIRECT SHEAR TEST RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-6**



BORING NO. :	BH-16	DEPTH (ft) :	5.0-6.5
DESCRIPTION :	Silty Sand with Gravel (SM)		
COHESION (psf) :	10	FRICTION ANGLE (degrees):	31
MOISTURE CONTENT (%) :	1.0	DRY DENSITY (pcf) :	95

NOTE: Ultimate Strength.

DIRECT SHEAR TEST RESULTS

Converse Consultants

Highway 86 Water Transmission Main, Phase 3 & 4
Approximately 13.4 Miles of 30-inch Pipeline
Riverside and Imperial Counties, California
For: Albert A. Webb Associates

Project No. **21-81-260-02**

Drawing No. **B-7**

Appendix C

Excavated Soil Photos

APPENDIX C

EXCAVATED SOIL PHOTOS

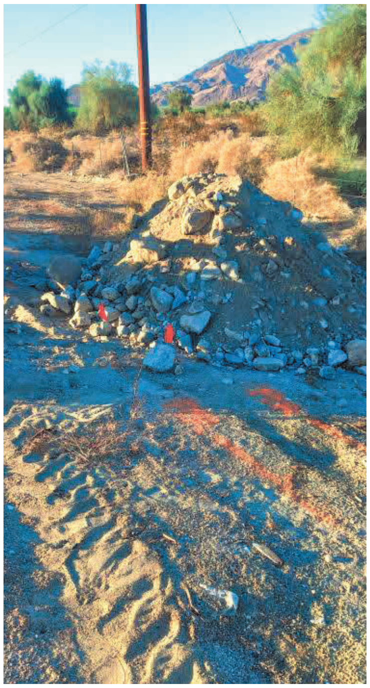


Photo No. 1: Spoils from TP-01.

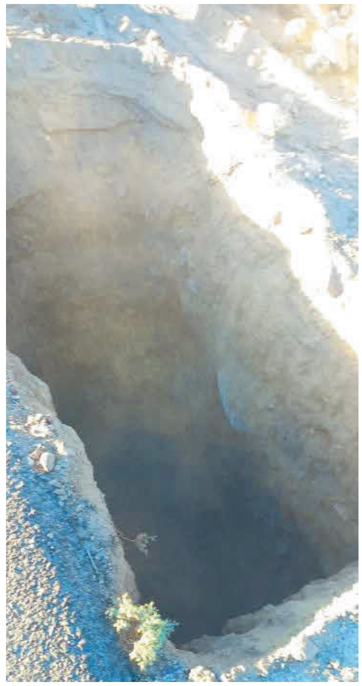


Photo No. 2: TP-01.

Photo No. 3: Spoils from TP-02.

Photo No. 4: TP-02.

Photo No. 5: Spoils from TP-03.

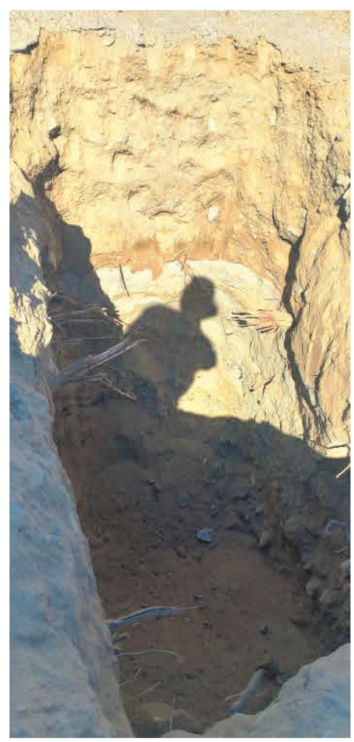


Photo No. 6: TP-03.


Photo No. 7: Spoils from TP-04.