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GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II COH WBS NO. S-000035-0197-3 HOUSTON, TEXAS

Reported to:
Texas American Engineering, LLC
Houston, Texas

by

Aviles Engineering Corporation
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Houston, Texas 77041
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REPORT NO. G166-14

February 2016

February 9, 2016

Mr. Jawed (James) A. Moheet, P.E.
Texas American Engineering, LLC
521 North Sam Houston Parkway East, Suite 550
Houston, Texas 77060

Reference: **Geotechnical Investigation**
Waterline Replacement in Imperial Valley Area Package II
WBS No.: S-000035-0197-3
Houston, Texas
AEC Report No. G166-14

Dear Mr. Moheet,

Aviles Engineering Corporation (AEC) is pleased to present this report of our geotechnical investigation for the above referenced project. The geotechnical investigation was authorized via email on October 16, 2014 by Mr. James Moheet, P.E. of Texas American Engineering, LLC, based on AEC's proposal G2014-09-05R2, dated October 8, 2015.

AEC appreciates the opportunity to be of service to you. Please call us if you have any questions or comments concerning this report or when we can be of further assistance.

Respectfully submitted,
Aviles Engineering Corporation
(TBPE Firm Registration No. F-42)

Wilber L. Wang, P.E.
Project Engineer

Shou Ting Hu, M.S.C.E., P.E.
President

Reports Submitted: 3 Texas American Engineering, LLC
1 File (electronic)

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EXECUTIVE SUMMARY

The report submitted herein presents the results of Aviles Engineering Corporation's (AEC) geotechnical investigation for the City of Houston's (COH) proposed water line replacement for the Imperial Valley Area Package II, in Houston, Texas (Houston Key Map 372Z, 373W, and 412D). A vicinity map is presented on Plate A-1, in Appendix A. Based on 100 percent complete drawings provided to AEC by Texas American Engineering, LLC (TAE), existing waterlines in the project area will be replaced with new 4 to 20 inch diameter waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 5.7 to 19.5 feet below grade. In addition, an aerial waterline bridge will also be located along Old Creek Road, crossing Harris County Flood Control District (HCFCD) Unit P144-01-00. The channel depth at the waterline crossing is approximately 12 feet deep.

1. Subsurface Soil Conditions: Generalized subsurface profiles along selected alignments are presented on Plates B-1a through B-7, in Appendix B.

   Based on Borings B-1 through B-55, the subsurface conditions at the site generally consist of firm to hard lean/fat/silty clay (CL/CH/CL-ML) from the ground surface to the boring termination depths. Granular soil strata (SC/SC-SM/ML) encountered is presented on Table 3. Approximately 2 feet of stiff to hard lean clay (CL) and silty clayey sand/silty clay (SC-SM/CL-ML) fill was encountered at the ground surface of Borings B-5, B-15, B-19, B-21, B-27, and B-55.

2. Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have slight to very high plasticity, with liquid limits (LL) ranging from 24 to 75, and plasticity indices (PI) ranging from 6 to 48. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. The cohesive soils encountered are classified as "CL-ML", "CL", and "CH" type soils and granular soils were classified as "SC", "SC-SM", and "ML" in accordance with ASTM D 2487.

3. Groundwater Conditions: Groundwater was encountered in Borings B-1, B-4, B-5, B-19, B-52, B-54, and B-55 during drilling at a depth of 8 to 25 feet and then rose to a depth of 11.7 to 23.9 feet after drilling was complete. Groundwater at the site could be pressurized. Groundwater was not encountered in the remaining borings during drilling.

4. Hazardous Materials: No signs of visual staining or odors were encountered during field drilling or during processing of the soil samples in the laboratory.

5. Design parameters and recommendations for installation of underground utilities by auger method are presented in Sections 5.1 and 5.2 of this report.

6. Engineering analyses and recommendations for driven pile waterline bridge foundations are presented in Section 5.3 of this report. In addition, AEC performed a slope stability analysis to determine if the bridge foundation installation would have an impact on the short-term slope stability of HCFCD Unit P144-01-00.

This Executive Summary is intended as a summary of the investigation and should not be used without the full text of this report.

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GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN
IMPERIAL VALLEY AREA PACKAGE II
COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

1.0 INTRODUCTION

1.1 General

The report submitted herein presents the results of Aviles Engineering Corporation's (AEC) geotechnical investigation for the City of Houston's (COH) proposed water line replacement for the Imperial Valley Area Package II, in Houston, Texas (Houston Key Map 372Z, 373W, and 412D). A vicinity map is presented on Plate A-1, in Appendix A. Based on 100 percent complete drawings provided to AEC by Texas American Engineering, LLC (TAE), existing waterlines in the project area will be replaced with new 4 to 20 inch diameter waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 5.7 to 19.5 feet below grade. In addition, an aerial waterline bridge will also be located along Old Creek Road, crossing Harris County Flood Control District (HCFCD) Unit P144-01-00. The channel depth at the waterline crossing is approximately 12 feet deep.

1.2 Purpose and Scope

The purpose of this geotechnical investigation is to evaluate the subsurface soil conditions along the alignment and develop geotechnical engineering recommendations for design and construction of waterlines by auger method. The scope of this geotechnical investigation is summarized below:

1. Drilling and sampling 55 geotechnical borings, ranging from 11 to 60 feet below existing grade;
2. Soil laboratory testing on selected soil samples;
3. Engineering analyses and recommendations for the installation of waterlines by auger method, including loadings on pipes, auger face stability, as well as bedding, lateral earth pressure parameters, trench stability, and backfill requirements for auger pits;
4. Engineering analyses and recommendations for driven pile waterline bridge foundations,
5. Slope stability analysis on the impact of waterline bridge foundation construction on the short term stability of the slopes of HCFCD Unit P144-01-00 along Old Creek Road;
6. Construction recommendations for installation of waterlines by auger methods and waterline bridge foundations.

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2.0 SUBSURFACE EXPLORATION

2.1 Soil Borings

Boring spacing and depths were selected in accordance with Chapter 11 of the latest edition of the COH Infrastructure Design Manual. In general, borings were spaced at an interval of approximately 500 feet along the alignments. AEC drilled and sampled a total of 55 soil borings ranging from 11 to 60 feet below existing grade.

The boring locations are shown on the Boring Location Plan on Plate A-2, in Appendix A. The total drilling footage is 862 feet. Boring survey data is summarized on Table 1 below, and is also included on the boring logs. Information provided in this report is based on 100 percent complete plan and profile drawings provided by TAE. The boring designations and depths, proposed waterline invert depths (both at the boring location and at nearby utility crossings, if any), and boring locations are presented in Table 1 below.

Table 1. Boring Number and Depth

Boring No.	Street	Boring Depth (ft)	Northing	Easting	Boring Elevation (ft)	Invert Depth at Boring / Nearest Utility Crossing[(1)] (ft)
B-1	Airline	16	13904126.7170	3106040.3320	84.726	10.9
B-2	Airline	12	13903683.4630	3106196.0970	83.584	6.7
B-3	Imperial Valley	13	13903652.7390	3108508.2950	80.388	7.4
B-4	Airline	25	13903167.8740	3106456.2650	83.2	19.5
B-5	Goodson	13	13903213.9610	3106964.0460	82.696	7.4
B-6	Goodson	13	13903260.4600	3107514.9480	81.529	8.0
B-7	Goodson	13	13903261.4510	3107990.4660	80.225	8.0
B-8	Goodson	21	13903285.0970	3108483.6450	79.871	16.0
B-9	Goodson	14	13903527.6900	3108934.4440	79.077	8.4
B-10	Goodson	14	13903588.1070	3109429.7270	79.183	8.3
B-11	Airline	14	13902613.9810	3106566.5270	82.625	8.9
B-12	Chipman	15	13902726.2390	3107320.2180	80.521	9.6
B-13	Imperial Valley	15	13903004.4820	3108842.6540	79.206	9.1

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Boring No.	Street	Boring Depth (ft)	Northing	Easting	Boring Elevation (ft)	Invert Depth at Boring / Nearest Utility Crossing[1] (ft)
B-14	La Fonda (W)	11	13903256.0250	3108984.2010	78.702	6.0
B-15	La Fonda (W)	12	13903321.6280	3109491.5150	79.42	6.6
B-16	Old Creek (S)	16	13903509.2610	3109880.0370	78.078	10.4
B-17	La Jolla	12	13903511.8060	3110294.9160	77.992	6.4
B-18	La Fonda (E)	12	13903684.9760	3110704.5160	77.496	6.5
B-19	Airline	14	13902169.2720	3106726.7990	82.923	9.0
B-20	W. Dyna	18	13902269.4530	3107237.0390	80.359	12.8
B-21	Casa Grande (W)	12	13902391.2160	3108361.3340	79.955	6.6
B-22	Casa Grande (W)	15	13902731.7150	3108759.8020	78.906	9.7
B-23	Casa Grande (W)	14	13903031.3320	3109150.6300	78.79	8.7
B-24	Casa Grande (W)	16	13903057.3840	3109631.1810	79.288	10.8
B-25	Old Creek (S)	14	13903111.2520	3110233.0110	77.877	8.9
B-26	Casa Grande (E)	12	13903399.4480	3110827.2120	78.199	7.0
B-27	Imperial Valley	12	13902719.2640	3109069.7010	79.259	6.6
B-28	Eldon	12	13902780.5040	3109459.1940	78.318	6.5
B-29	Tonya	14	13902941.4560	3110038.1060	78.227	8.3
B-30	La Jolla	12	13903113.2260	3110649.2590	77.03	7.0
B-31	Dogwood Tree	11	13903108.5700	3111131.9820	76.68	6.0
B-32	Airline	12	13901704.8370	3106884.1870	81.526	6.6
B-33	Chipman	16	13901859.1370	3107446.3850	80.427	10.8
B-34	Buckle	14	13902030.1600	3108316.1940	79.649	8.8
B-35	Merritt	12	13902323.3670	3109059.1860	79.516	6.3
B-36	Dyna	11	13902513.5340	3109572.1620	78.705	5.7
B-37	Dyna	12	13902651.1450	3110077.4270	78.436	6.4
B-38	Hardwicke (W)	14	13901439.8880	3107263.6710	80.32	8.8
B-39	Hardwicke (W)	16	13901625.4110	3107746.0690	78.739	10.9
B-40	Hardwicke (W)	14	13901693.9690	3108216.3880	78.984	8.5
B-41	Hardwicke (E)	14	13902240.7270	3109504.0500	78.146	8.1
B-42	Hardwicke (E)	11	13902258.2980	3109895.3660	77.716	5.9
B-43	Hardwicke (E)	12	13902494.9220	3110306.8900	77.405	6.2
B-44	Old Creek (S)	14	13902762.7430	3110540.1610	77.988	8.7

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Boring No.	Street	Boring Depth (ft)	Northing	Easting	Boring Elevation (ft)	Invert Depth at Boring / Nearest Utility Crossing[(1)] (ft)
B-45	Chipman	16	13901283.7950	3107890.5640	79.596	10.7
B-46	Glazebrook	14	13901412.0230	3108315.8930	79.384	8.5
B-47	Glazebrook	13	13901712.5490	3108702.2240	80.862	7.3
B-48	Glazebrook	15	13901953.8100	3109123.6610	78.482	9.7
B-49	Glazebrook	13	13901975.8540	3109662.3660	78.393	7.2
B-50	Dogwood Tree	14	13902046.5780	3110192.1310	77.734	8.3
B-51	Dogwood Tree	18	13902372.3950	3110557.8060	77.413	12.1
B-52	Dogwood Tree	18	13902705.7100	3110930.6420	76.796	12.3
B-53	La Jolla	12	13902445.0750	3111266.7460	76.411	6.9
B-54	Old Creek (N)	60	13903750.3540	3109738.4580	79.662	5.8
B-55	Old Creek (N)	60	13903852.4410	3109756.9430	80.348	7.9

Note: (1) Based on 100 percent complete drawings provided by TAE.

Existing concrete pavement at Borings B-1 through B-55 were first cut with a core barrel prior to field drilling. The field drilling was performed with a truck-mounted drilling rig using dry auger method. Undisturbed samples of cohesive soils were obtained from the borings by pushing 3-inch diameter thin-wall, seamless steel Shelby tube samplers in general accordance with ASTM D 1587. Granular soils were sampled with a 2-inch split-barrel sampler in accordance with ASTM D 1586. Standard Penetration Test resistance (N) values were recorded for the granular soils as "Blows per Foot" and are shown on the boring logs. Strength of the cohesive soils was estimated in the field using a hand penetrometer. The undisturbed samples of cohesive soils were extruded mechanically from the core barrels in the field and wrapped in aluminum foil; all samples were sealed in plastic bags to reduce moisture loss and disturbance. The samples were then placed in core boxes and transported to the AEC laboratory for testing and further study. Bore holes were grouted with cement-bentonite upon completion of drilling and existing pavement was patched with non-shrink grout.

3.0 LABORATORY TESTING PROGRAM

Soil laboratory testing was performed by AEC personnel. Samples from the borings were examined and classified in the laboratory by a technician under the supervision of a geotechnical engineer. Laboratory tests were performed on selected soil samples in order to evaluate the engineering properties of the

foundation soils in accordance with applicable ASTM Standards. Atterberg limits, moisture contents, percent passing a No. 200 sieve, and dry unit weight tests were performed on typical samples to establish the index properties and confirm field classification of the subsurface soils. Strength properties of cohesive soils were determined by means of torvane (TV), unconfined compression (UC), and undrained-unconsolidated (UU) triaxial tests performed on undisturbed samples. The test results are presented on the boring logs. Details of the soils encountered in the borings are presented on Plates A-3 through A-58, in Appendix A. A key to the boring logs, classification of soils for engineering purposes, terms used on boring logs, and reference ASTM Standards for laboratory testing are presented on Plates A-59 through A-61, in Appendix A. A summary of lab test results is presented on Plates A-62 through A-74, in Appendix A.

4.0 SITE CONDITIONS

A summary of existing pavement sections encountered in our borings is presented in Table 2 below.

Table 2. Pavement Encountered at Borings

Boring No.	Street	Pavement Section
B-1	Airline	8.25” concrete
B-2	Airline	8.75” concrete
B-3	Imperial Valley	6” concrete
B-4	Airline	7” concrete
B-5	Goodson	6.5” concrete
B-6	Goodson	7” concrete
B-7	Goodson	7” concrete
B-8	Goodson	7” concrete
B-9	Goodson	5.25” concrete
B-10	Goodson	5” concrete
B-11	Airline	9” concrete
B-12	Chipman	6.5” concrete
B-13	Imperial Valley	5.5” concrete
B-14	La Fonda (W)	6” concrete
B-15	La Fonda (W)	6” concrete
B-16	Old Creek (S)	7” concrete
B-17	La Jolla	7.25” concrete

Boring No.	Street	Pavement Section
B-18	La Fonda (E)	5” concrete
B-19	Airline	9” concrete, 15” stabilized clayey sand
B-20	W. Dyna	7” concrete, 15” stabilized clay
B-21	Casa Grande (W)	7” concrete
B-22	Casa Grande (W)	5.5” concrete
B-23	Casa Grande (W)	5.75” concrete
B-24	Casa Grande (W)	5.5” concrete
B-25	Old Creek (S)	5.25” concrete
B-26	Casa Grande (E)	6” concrete
B-27	Imperial Valley	6” concrete
B-28	Eldon	6” concrete
B-29	Tonya	6.5” concrete
B-30	La Jolla	5.75” concrete
B-31	Dogwood Tree	7” concrete
B-32	Airline	8” concrete
B-33	Chipman	7” concrete
B-34	Buckle	7” concrete
B-35	Merritt	6” concrete
B-36	Dyna	5.25” concrete
B-37	Dyna	7” concrete
B-38	Hardwicke (W)	6.25” concrete
B-39	Hardwicke (W)	6” concrete
B-40	Hardwicke (W)	5.75” concrete
B-41	Hardwicke (E)	5.5” concrete
B-42	Hardwicke (E)	6.5” concrete
B-43	Hardwicke (E)	5.75” concrete
B-44	Old Creek (S)	5.75” concrete
B-45	Chipman	6” concrete
B-46	Glazebrook	5.5” concrete
B-47	Glazebrook	7.25” concrete
B-48	Glazebrook	5.5” concrete
B-49	Glazebrook	5.5” concrete
B-50	Dogwood Tree	7” concrete
B-51	Dogwood Tree	5.25” concrete
B-52	Dogwood Tree	6” concrete

Boring No.	Street	Pavement Section
B-53	La Jolla	7” concrete
B-54	Old Creek (N)	7” concrete
B-55	Old Creek (N)	6.25” concrete

4.1 Subsurface Conditions

Generalized subsurface profiles along selected waterline alignments are presented on Plates B-1a through B-7, in Appendix B.

Based on Borings B-1 through B-55, the subsurface conditions at the site generally consist of firm to hard lean/fat/silty clay (CL/CH/CL-ML) from the ground surface to the boring termination depths. Granular soil strata (SC/SC-SM/ML) encountered is presented on Table 3. Approximately 2 feet of stiff to hard lean clay (CL) and silty clayey sand/silty clay (SC-SM/CL-ML) fill was encountered at the ground surface of Borings B-5, B-15, B-19, B-21, B-27, and B-55.

Table 3. Granular and Soft/Weak Soils Encountered in Borings

Boring	Depth to Granular or Soft/Weak Soil	Granular Soil Type
B-3	8’ to 13’	Clayey Sand (SC)
B-19	2’ to 4’ 4’ to 6’	Fill: Silty Clayey Sand (SC-SM) Soft to stiff, Lean Clay w/Sand (CL)
B-24	12’ to 16’	Silty Clayey Sand (SC-SM)
B-30	0.5’ to 4’	Clayey Sand (SC)
B-38	6’ to 8’	Very soft to firm, Sandy Silty Clay (CL-ML)
B-55	27’ to 32’	Medium dense, Silt (ML)

Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have slight to very high plasticity, with liquid limits (LL) ranging from 24 to 75, and plasticity indices (PI) ranging from 6 to 48. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. The cohesive soils encountered are classified as “CL-ML”, “CL”, and “CH” type soils and granular soils were classified as “SC”, ”SC-SM”, and “ML” in accordance with ASTM D 2487. “CH” soils undergo significant volume changes due to seasonal changes in soil moisture contents. “CL” type soils with lower

LL (less than 40) and PI (less than 20) generally do not undergo significant volume changes with changes in moisture content. However, "CL" soils with LL approaching 50 and PI greater than 20 essentially behave as "CH" soils and could undergo significant volume changes. Slickensides were encountered in the fat clays.

Groundwater Conditions: Groundwater was encountered in Borings B-1, B-4, B-5, B-19, B-52, B-54, and B-55 during drilling at a depth of 8 to 25 feet and then rose to a depth of 11.7 to 23.9 feet after drilling was complete. Groundwater at the site could be pressurized. Groundwater was not encountered in the remaining borings during drilling. Groundwater at the site could be pressurized. Detailed groundwater levels encountered in the borings are summarized in Table 4. After completion of drilling, two borings were converted to piezometers. Piezometer installation details are presented on Plates B-8 and B-9, in Appendix B. Piezometer installation and plugging reports are presented on Plates G-1 through G-4, in Appendix G.

Table 4. Groundwater Depths below Existing Ground Surface

Boring/PZ No.	Date Drilled	Boring/PZ Depth (ft)	Groundwater Depth (ft)	Groundwater Depth in Piezometer (ft)
B-1	11/25/14	16	12 (Drilling) Dry (Complete)	-
B-2	11/24/14	12	Dry (Drilling)	-
B-3	11/24/14	13	Dry (Drilling)	-
B-4/PZ-1	11/11/14	25/20	16 (Drilling) 23 (Complete)	8.34 (11/17/14)
B-5	11/17/14	13	12 (Drilling) 11.7 (Complete)	-
B-6	11/17/14	13	Dry (Drilling)	-
B-7	11/17/14	13	Dry (Drilling)	-
B-8	11/17/14	21	Dry (Drilling)	-
B-9	11/17/14	14	Dry (Drilling)	-
B-10	11/17/14	14	Dry (Drilling)	-
B-11	11/24/14	14	Dry (Drilling)	-
B-12	11/18/14	15	Dry (Drilling)	-
B-13	11/20/14	15	Dry (Drilling)	-
B-14	11/20/14	11	Dry (Drilling)	-
B-15	11/20/14	12	Dry (Drilling)	-
B-16	11/17/14	16	Dry (Drilling)	-
B-17	11/17/14	12	Dry (Drilling)	-

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Boring/PZ No.	Date Drilled	Boring/PZ Depth (ft)	Groundwater Depth (ft)	Groundwater Depth in Piezometer (ft)
B-18	11/17/14	12	Dry (Drilling)	-
B-19	11/24/14	14	8 (Drilling) 12.7 (Complete)	-
B-20	11/18/14	18	Dry (Drilling)	-
B-21	11/19/14	12	Dry (Drilling)	-
B-22	11/20/14	15	Dry (Drilling)	-
B-23	11/20/14	14	Dry (Drilling)	-
B-24	11/20/14	16	Dry (Drilling)	-
B-25	11/20/14	14	Dry (Drilling)	-
B-26	11/25/14	12	Dry (Drilling)	-
B-27	11/25/14	12	Dry (Drilling)	-
B-28	11/25/14	12	Dry (Drilling)	-
B-29	11/25/14	14	Dry (Drilling)	-
B-30	11/25/14	12	Dry (Drilling)	-
B-31	11/20/14	11	Dry (Drilling)	-
B-32	11/24/14	12	Dry (Drilling)	-
B-33	11/18/14	16	Dry (Drilling)	-
B-34	11/19/14	14	Dry (Drilling)	-
B-35	11/25/14	12	Dry (Drilling)	-
B-36	11/25/14	11	Dry (Drilling)	-
B-37	11/25/14	12	Dry (Drilling)	-
B-38	11/18/14	14	Dry (Drilling)	-
B-39	11/18/14	16	Dry (Drilling)	-
B-40	11/18/14	14	Dry (Drilling)	-
B-41	11/25/14	14	Dry (Drilling)	-
B-42	11/25/14	11	Dry (Drilling)	-
B-43	11/25/14	12	Dry (Drilling)	-
B-44	11/25/14	14	Dry (Drilling)	-
B-45	11/19/14	16	Dry (Drilling)	-
B-46	11/19/14	14	Dry (Drilling)	-
B-47	11/19/14	13	Dry (Drilling)	-
B-48	11/19/14	15	Dry (Drilling)	-
B-49	11/19/14	13	Dry (Drilling)	-
B-50	11/19/14	14	Dry (Drilling)	-
B-51	11/19/14	18	Dry (Drilling)	-

Boring/PZ No.	Date Drilled	Boring/PZ Depth (ft)	Groundwater Depth (ft)	Groundwater Depth in Piezometer (ft)
B-52	11/19/14	18	8 (Drilling) 16.1 (Complete)	-
B-53	11/19/14	12	Dry (Drilling)	-
B-54/PZ-2	11/10/14	60/25	23 (Drilling) 17 (1/4 hr.)	10.60 (11/17/14)
B-55	11/7/14	60	25 (Drilling) 23.9 (1/4 hr.)	

The information in this report summarizes conditions found on the dates the borings were drilled. It should be noted that our groundwater observations are short-term; groundwater depths and subsurface soil moisture contents will vary with environmental variations such as frequency and magnitude of rainfall and the time of year when construction is in progress.

4.2 Hazardous Materials

No signs of visual staining or odors were encountered during field drilling or during processing of the soil samples in the laboratory.

4.3 Geologic Faults

AEC performed a preliminary fault investigation, which included a review of available literature, aerial photographs, public maps, and limited field observations. According to the published maps "*Principal Active Faults of the Houston Area (after O'Neill and Van Siclen, May 1984)*", and "*Principal Surface Faults in the Central Houston Metropolitan Area (after O' Neill, Van Siclen, with additions by C. Norman, May 13, 2004)"*, no documented faults are located in the project area. The closest fault to the project area is the West Fault located west of Interstate 45 approximately 0.7 miles from the northwestern corner of the project area. However, according to *Principal Faults in the Houston Texas Metropolitan Area* (Shah and Lanning-Rush, 2005, USGS in cooperation with Harris-Galveston Coastal Subsidence District: Scientific Investigations Map 2874), the West Fault is located east of Interstate 45 crossing the project area. Their map indicates that the fault crosses Airline Drive just north of Hardwicke Road and strikes northeastward through the project area and crossing Old Creek Road just north of Goodson Drive. AEC could not locate any literature regarding the West Fault after 2005 which would support or refute the location identified in

the 2005 literature. Other reviewed literature identified the location of the West Fault as west of Interstate 45.

Limited field observations were made by AEC Senior Geologist in the project area and in the area west of Interstate 45 where O'Neill and Van Siclen's map identify the West Fault to determine the location of the West Fault. No evidences of faulting were observed at either location. Because no evidence of faulting was found, movement along the fault regardless of its true location must be minimal and slow. Therefore AEC does not recommend any further fault studies for the project area.

Limitations: The preliminary fault investigation provided in this report is limited to a review of literature, aerial photographs and maps and our limited field observations, and distances are scaled from maps. Faults may exist in, cross, or adjoin the project alignment which were not identified in this report due to the following reasons: not observed during the reconnaissance due to limitations of the scope of work and cost; the presence of obscuring vegetation and environmental features; modification of the land surface by human activities; and lack of documentation in the literature. Faults may also be present below ground but do not currently have surface expressions. Identification of these faults is beyond the scope of work for this project.

4.4 Subsurface Variations

It should be emphasized that: (i) at any given time, groundwater depths can vary from location to location, and (ii) at any given location, groundwater depths can change with time. Groundwater depths will vary with seasonal rainfall and other climatic/environmental events. Subsurface conditions may vary away from and between the boring locations.

Clay soils in the Houston area typically have secondary features such as slickensides and siltstone fragments, and contain sand/silt seams/lenses/layers/pockets. It should be noted that the information in the boring logs is based on 3-inch diameter soil samples which were obtained continuously at intervals of 2 feet in the top 20 feet of the borings, then at intervals of 5 feet thereafter to the boring termination depths. A detailed description of the soil secondary features may not have been obtained due to the small sample size and sampling interval between the samples. Therefore, while a boring log shows some soil secondary features, it should not be assumed that the features are absent where not indicated on the boring logs.

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5.0 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Based on 100 percent complete drawings provided to AEC by TAE, existing waterlines in the project area will be replaced with new 4 to 20 inch diameter waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 5.7 to 19.5 feet below grade. In addition, an aerial waterline bridge will also be located along Old Creek Road, crossing HCFCD Unit P144-01-00. The channel depth at the waterline crossing is approximately 12 feet deep.

5.1 Geotechnical Parameters for Underground Utilities

Recommended geotechnical parameters for the subsurface soils along the alignment to be used for design of underground utilities are presented on Plates C-1 through C-6, in Appendix C. The design values are based on the results of field and laboratory test data on individual boring logs as well as our experience. It should be noted that because of the variable nature of soil stratigraphy, soil types and properties along the alignment or at locations away from a particular boring may vary substantially.

5.2 Installation of Underground Utilities by Auger Method

Underground utilities installed by auger methods should be designed and installed in accordance with Section 02447 of the latest edition of the City of Houston Standard Construction Specifications (COHSCS).

The Contractor is responsible for selecting, designing, installing, maintaining and monitoring safe augering systems and retaining professionals who are qualified and experienced to perform the tasks and who are capable of modifying the system, as required. The following discussion provides general guidelines to the Contractor for augering methods. The information in this report should be reviewed so that appropriate augering equipment and techniques can be planned and factored into the construction plan and cost estimate.

5.2.1 Loadings on Pipes

Underground utilities support the weight of the soil and water above the crown, as well as roadway traffic and any structures that exist above the utilities.

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Earth Loads: The vertical soil load W_e can be calculated as the larger of the two values from Equations (1) and (3):

$W_e = C_d \gamma B_d^2$ .....Equation (1)

$C_d = [1 - e^{-2K\mu'(H/B_d)}]/(2K\mu')$ .....Equation (2)

$W_e = \gamma B_c H$ .....Equation (3)

where: W_e = trench fill load, in pounds per linear foot (lb/ft);
C_d = trench load coefficient, see Plate C-7, in Appendix C;
γ = effective unit weight of soil over the conduit, in pounds per cubic foot (pcf);
B_d = trench width at top of the conduit < 1.5 B_c (ft);
B_c = outside diameter of the conduit (ft);
H = variable height of fill (ft);
when the height of fill above the top of the conduit H_c >2 B_d, H = H_h (height of fill above the middle of the conduit). When H_c < 2 B_d, H varies over the height of the conduit; and
$K\mu'$ = 0.1650 maximum for sand and gravel,
0.1500 maximum for saturated top soil,
0.1300 maximum for ordinary clay,
0.1100 maximum for saturated clay.

When underground conduits are located below groundwater, the total vertical dead loads should include the weight of the projected volume of water above the conduits.

Traffic Loads: The vertical stress on top of an underground conduit, p_L (psf), resulting from traffic loads (from a HS-20 truck) can be obtained from Plate C-8, in Appendix C. The live load on top of the underground conduit can be calculated from Equation (4):

$W_L = p_L B_c$ .....Equation (4)

where: W_L = live load on the top of the conduit (lb/ft);
p_L = vertical stress (on the top of the conduit) resulting from traffic loads (psf);
B_c = outside diameter of the conduit, (ft);

Lateral Loads: The lateral soil pressure p_l can be calculated from Equation (5); hydrostatic pressure should be added, if applicable.

$p_l = 0.5 (\gamma H_h + p_s)$ .....Equation (5)

where: H_h = height of fill above the center of the conduit (ft);
γ = effective unit weight of soil over the conduit (pcf);
p_s = vertical pressure on conduit resulting from traffic and/or construction equipment (psf).

5.2.2 Auger Pits

Auger pits are required for starting and ending pipes. They should be designed and constructed in accordance with Section 02447, Subsection 3.04 of the latest edition of the COHSCS. Auger pits that are constructed in conjunction with open cut methods should be in accordance with Section 02317 of the latest edition of the COHSCS.

Reaction Walls: For the braced pit walls to be used to provide passive reaction for pipe jacking, passive earth pressure can be calculated using Equation (6); we recommend that a factor of safety of 2.0 be used for passive earth pressure. The design soil parameters for reaction wall design are presented on Plates C-1 through C-6, in Appendix C.

$$p_p = \gamma z K_p + 2c(K_p)^{1/2} \quad \text{.....Equation (6)}$$

where, p_p = passive earth pressure (psf);
γ = wet unit weight of soil (pcf);
z = depth below ground surface for the point under consideration (ft);
K_p = coefficient of passive earth pressure;
c = cohesion of clayey soils (psf).

5.2.3 Auger Pit Excavation

Based on Table 3 in Section 4.1 of this report, granular or soft/weak clay soils could be encountered at a depth starting from ground surface to a depth of 2 feet below the bottom of the auger pit excavation in the vicinity of Borings B-3, B-19, B-24, B-30, and B-38. Based on Table 4 in Section 4.1 of this report, groundwater was encountered within the auger pit zones in the vicinity of Borings B-1, B-4, B-19, and B-52. If groundwater or saturated sands are encountered during auger pit excavation, groundwater control could be required. Groundwater control recommendations are presented in Section 6.2 of this report.

Cohesive soils in the Houston area contain many secondary features which affect trench stability, including sand seams, siltstone fragments, and slickensides. Slickensides are shiny weak failure planes which are commonly present in fat clays; such clays often fail along these weak planes when they are not laterally

supported, such as in an open excavation. The Contractor should not assume that slickensides and sand seams/layers/pockets are absent where not indicated on the logs.

The Contractor should be responsible for designing, constructing and maintaining safe excavations. The excavations should be performed in a manner so that they do not cause any distress to existing structures.

Trenches 20 feet and Deeper: The Occupational Safety and Health Administration (OSHA) requires that shoring or bracing for trenches 20 feet and deeper be specifically designed by a licensed professional engineer.

Trenches Less than 20 Feet Deep: Trench excavations that are less than 20 feet deep may be shored, sheeted and braced, or laid back to a stable slope for the safety of workers, the general public, and adjacent structures, except for excavations which are less than 5 feet deep and verified by a competent person to have no cave-in potential. The excavation and trenching should be in accordance with OSHA Safety and Health Regulations, 29 CFR, Part 1926. Recommended OSHA soil types for trench design for existing soils can be found on Plates C-1 through C-6, in Appendix C. Fill soils are considered OSHA Class 'C'; submerged cohesive soils should also be considered OSHA Class 'C', unless they are dewatered first.

Critical Height is defined as the height a slope will stand unsupported for a short time; in cohesive soils, it is used to estimate the maximum depth of open-cuts at given side slopes. Critical Height may be calculated based on the soil cohesion. Values for various slopes and cohesion are shown on Plate D-1, in Appendix D. Cautions listed below should be exercised in use of Critical Height applications:

1. No more than 50 percent of the Critical Height computed should be used for vertical slopes. Unsupported vertical slopes are not recommended where granular soils or soils that will slough when not laterally supported are encountered within the excavation depth.

2. If the soil at the surface is dry to the point where tension cracks occur, any water in the crack will increase the lateral pressure considerably. In addition, if tension cracks occur, no cohesion should be assumed for the soils within the depth of the crack. The depth of the first waler should not exceed the depth of the potential tension crack. Struts should be installed before lateral displacement occurs.

3. Shoring should be provided for excavations where limited space precludes adequate side slopes, e.g., where granular soils will not stand on stable slopes and/or for deep open cuts.

4. All excavation, trenching and shoring should be designed and constructed by qualified professionals in accordance with OSHA requirements.

The maximum (steepest) allowable slopes for OSHA Soil Types for excavations less than 20 feet are presented on Plate D-2, in Appendix D.

If limited space is available for the required open trench side slopes, the space required for the slope can be reduced by using a combination of bracing and open cut as illustrated on Plate D-3, in Appendix D. Guidelines for bracing and calculating bracing stress are presented below.

Computation of Bracing Pressures: The following method can be used for calculating earth pressure against bracing for open cuts. Lateral pressure resulting from construction equipment, traffic loads, or other surcharge should be taken into account by adding the equivalent uniformly distributed surcharge to the design lateral pressure. Hydrostatic pressure, if any, should also be considered. The active earth pressure at depth z can be determined by Equation (7). The design soil parameters for trench bracing design are presented on Plates C-1 through C-6, in Appendix C.

$$p_a = (q_s + \gamma h_1 + \gamma' h_2) K_a - 2c\sqrt{K_a} + \gamma_w h_2 \qquad \text{.....Equation (7)}$$

where: p_a = active earth pressure (psf);
q_s = uniform surcharge pressure (psf);
γ, γ' = wet unit weight and buoyant unit weight of soil (pcf);
h_1 = depth from ground surface to groundwater table (ft);
h_2 = $z-h_1$, depth from groundwater table to the point under consideration (ft);
z = depth below ground surface for the point under consideration (ft);
K_a = coefficient of active earth pressure;
c = cohesion of clayey soils (psf); c can be omitted conservatively;
γ_w = unit weight of water, 62.4 pcf.

Pressure distribution for the practical design of struts in open cuts for clays and sands are illustrated on Plates D-4 through D-6, in Appendix D.

Bottom Stability: In open-cuts, it is necessary to consider the possibility of the bottom failing by heaving, due to the removal of the weight of excavated soil. Heaving typically occurs in soft plastic clays when the excavation depth is sufficiently deep enough to cause the surrounding soil to displace vertically due to bearing capacity failure of the soil beneath the excavation bottom, with a corresponding upward movement of the soils in the bottom of the excavation. In fat and lean clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In very sandy and silty lean clays and granular

soils, heave can occur if an artificially large head of water is created due to installation of impervious sheeting while bracing the cut. This can be mitigated if groundwater is lowered below the excavation by dewatering the area. Guidelines for evaluating bottom stability in clay soils are presented on Plate D-7, in Appendix D.

If the excavation extends below groundwater and the soils at or near the bottom of the excavation are mainly sands or silts, the bottom can fail by blow-out (boiling) when a sufficient hydraulic head exists. The potential for boiling or in-flow of granular soils increases where the groundwater is pressurized. To reduce the potential for boiling of excavations terminating in granular soils below pressurized groundwater, the groundwater table should be lowered at least 5 feet below the excavation in accordance with Section 01578 of the latest edition of the City of Houston Standard General Requirements (COHSGR).

Calcareous nodules, siltstone fragments, silt/sand seams, and fat clays with slickensides were encountered in some of the borings. These secondary structures may become sources of localized instability when they are exposed during excavation, especially when they become saturated. Such soils have a tendency to slough or cave in when not laterally confined, such as in trench excavations. The Contractor should be aware of the potential for cave-in of the soils. Low plasticity soils (silts and clayey silts) will lose strength and may behave like granular soils when saturated.

5.2.4 Auger Face Stability During Construction

A Stability Factor, $N_t = (P_z - P_a)/C_u$ may be used to evaluate the stability of an unsupported bore face in cohesive soils (N_t is not applicable to granular soils), where P_z is the overburden pressure to the bore centerline; P_a is the equivalent uniform interior pressure applied to the face; and C_u is the soil undrained shear strength. For augering operations, no interior pressure is applied. Generally, N_t values of 4 or less are desirable as it represents a practical limit below which augering may be accomplished without significant difficulty. Higher N_t values usually lead to large deformations of the soil around the bore and problems associated with increased subsidence. It should be noted that the exposure time of the face is most important; with time, creep of the soil will occur, resulting in a reduction of shear strength. The N_t values will therefore increase when construction is slow.

An N_t value of about 0.2 to 1.5 was estimated for the cohesive soils encountered within the auger zone of approximately 5.7 to 16.0 feet below existing grade for Borings B-1 through B-3 and B-5 through B-55. A

N_t value of about 3.6 was estimated for Boring B-4 within the auger zone of approximately 19.5 feet below existing grade. Note that the cohesive soils have secondary structures such as fissures, sand seams, and sand lenses which can cause the bore face to become unstable. Where granular or soft cohesive soils are encountered, the Contractor should make provisions for casing to stabilize the auger holes. The Contractor should not base their bid on the above information alone, since granular soils may be encountered between boring locations; the Contractor should verify the subsurface conditions between boring locations or add a contingency.

5.2.5 Backfill for Auger Pits

Backfill for auger pits should be in accordance with Section 02317 of the latest edition of the COHSCS. Embedment material and backfill should be placed in loose lifts not exceeding 8 inches and compacted in accordance with Section 02317 of the latest edition of the COHSCS.

5.2.6 Influence of Augering on Adjacent Structures

Ground Subsidence: Augering in soft ground often induces some degree of settlement (ground subsidence) of the overlying ground surface. If such settlement is excessive, it may cause damage to existing structures and services located above and/or near the auger zone.

Predicting the amount of loss of ground (or ground subsidence) due to augering is very difficult, primarily because of the uncertainty involved in the analysis: such as heterogeneous soil properties, subsurface variability, or lack of information about proposed construction equipment and techniques.

Loss of Soil Support for Adjoining Structures: Augering operations, when located close to existing structures, will relieve the vertical and lateral soil support that these structures rely upon for their foundation bearing capacity and lateral soil support. This can result in distress to the existing structures if appropriate precautions are not taken.

Measures to Reduce Distress from Augering: Impact to existing foundations and structures can be mitigated by following proper augering procedures. Some methods to mitigate movement and/or distress to existing structures include:

- Supporting the augering excavation with steel or rigid concrete casing or the pipe material itself, as soon as the excavation is advanced and at short intervals; and
- proper grouting of the annular spaces; the type of equipment and method chosen will require the services of a specialty contractor.

To reduce the potential for the augering to influence the existing foundations or structures, we recommend that the outer edge of the influence zone of the auger tunnel be a minimum of 5 feet from the outer edge of the bearing (stress) zone of existing foundations. The bearing (stress) zone is defined by a line drawn downward from the outer edge of an existing foundation and inclined at an angle of 45 degrees to the vertical.

The auger influence zone is assumed to extend a distance of about 2.5i from the center of the auger tunnel, as shown on Plate D-8, in Appendix D. We estimated the resulting influence zones (extending from the centerline of the auger tunnel) to be approximately 5 to 16 feet (depending on invert depths ranging from 5.7 to 19.5 feet below grade). We emphasize that the size of the influence zone of an auger tunnel is difficult to determine because several factors influence the response of the soil to augering operations including type of soil, ground water level, type of augering equipment, method of augering, experience of operator and other construction in the vicinity. The values of auger tunnel influence zone presented herein are therefore rough estimates.

We recommend that the following situations be evaluated on a case by case basis, where:

- augering cannot be located farther than the minimum distance recommended above;
- augering cannot be located outside the stress zone of the foundations for existing structures;
- unstable soils are encountered near existing structures;
- heavily loaded or critical structures are located close to the influence zone of the auger tunnels;

As an option, existing structure foundations should be protected by adequate shoring or strengthened by underpinning or other techniques, provided that augering cannot be located outside the stress zone of the existing foundations.

Disturbance and loss of ground from the augering operation may create surface soil disturbance and subsidence which in turn may cause distress to existing structures (including pavements) located in the zone of soil disturbance. Any open-cut excavation in the proposed augering areas should be adequately shored.

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5.3 Waterline Bridge

Based on the drawings provided by TAE, a waterline aerial crossing will be located along Old Creek (N), crossing over HCFCD Unit P144-01-00. Based on the drawings, the waterline bridge will be an 8 inch diameter steel pipe, supported by two 16 inch square concrete piles (with an interior span of 38 feet). The pile tip elevation is at 58.00 feet above Mean Sea Level (MSL). Based on the drawings, the ultimate ditch flowline is at an elevation of 68.80 feet above MSL. The north top of bank elevation is approximately 81.2 feet above MSL, while the south top of bank elevation is approximately 80.5 feet above MSL. The 100 year flood elevation is at 82.50 feet above MSL.

5.3.1 Precast Driven Piles

AEC performed driven pile analyses using the Federal Highway Administration (FHWA) publication, (1997) "FHWA-HI-97-013 Design and Construction of Driven Pile Foundations". In the analyses, we neglected skin friction from the existing ground surface to 10 feet below the bottom of the channel (i.e. total depth of 22 feet), considering the shafts are located at a wet crossing. We did not consider scour depth, since the provided drawings indicate that the existing ditch slopes and bottom are protected with a concrete liner. We used a factor of safety (FS) of 2 and 3 for skin friction and end bearing, respectively.

The total allowable compressive axial bearing capacity of an untapered driven pile is the sum of the allowable skin friction (obtained by multiplying the shaft perimeter by the allowable unit cumulative skin friction beginning from 22 feet below existing grade to the design depth) and the allowable end bearing (obtained by multiplying the pile cross-sectional area by the allowable unit end bearing at the design depth).

The allowable accumulative unit skin friction capacity vs. depth curve and allowable compressive load vs. depth curves for 16-inch square precast concrete piles are presented on Plates E-1 through E-3, in Appendix E.

Lateral Capacity: Design soil parameters for lateral load analyses using the LPile Plus computer program are presented on Plate E-4, in Appendix E. For LPile analyses, we recommend that the top 3 feet of soil be modeled as weak soil, due to potential desiccation and shrinkage of the near surface clays.

Maximum Loads and Lengths: AEC recommends the design loads and lengths for driven piles should not exceed the maximum allowable pile service loads presented on Table 5.

Table 5. Maximum Allowable Pile Load[1]

Pile Size (inch)	Maximum Length (feet)	Maximum Allowable Service Loads (tons, per pile)
16	85	75
18	95	90
20	105	110
24	125	140

Note (1): Based on Texas Department of Transportation recommendations.

Design and Driving Stresses: AEC recommends that the design stresses and driving stresses not exceed those presented in Table 6. Concrete must have a minimum 28-day compressive strength, f'_c of 5,000 psi or greater (based on FHWA recommendations), while the effective prestress after losses, f_{pe}, is typically greater than 725 psi.

Table 6. Maximum Stresses for Concrete Piles[3]

Design Stresses	$0.33\ f'_c - 0.27\ f_{pe}$ (on gross concrete area)
Driving Stresses	Compression Limit $< 0.85\ f'_c - f_{pe}$ (on gross concrete area)
	Tension Limit[1] $< 0.25(f'_c)^{0.5} + f_{pe}$ (on gross concrete area)
	Tension Limit[2] $< f_{pe}$ (on gross concrete area)

Note (1): Under Normal Environments;
(2): Under Severe Corrosive Environments;
(3): Based on FHWA recommendations.

Pile Spacing: Based on the drawings, the pipeline bridge will be supported by two individual 16 inch square piles, which are 38 feet apart. Since the pile spacing is greater than 3 pile diameters, no pile group reduction factor is required.

Driven Pile Settlements: Based on the soil conditions encountered and the anticipated structural loads, we estimate that driven piles, designed and constructed as recommended in this report, will experience total settlements on the order of 1 inch.

Pile Installation Considerations: Only qualified experienced Contractors should be selected to install piles. Each pile should be carefully examined by qualified personnel before driving; defective piles should be rejected. Prestressed concrete piles should be installed in accordance with Item 409 of the 2014 Texas Department of Transportation (TxDOT) Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, or local equivalent specification.

Pile driving should be performed in accordance with Item 404 of the 2014 TxDOT Standard Specifications. It is the Contractor's responsibility to select appropriate hammer type, ram weight, maximum ram stroke, minimum hammer energy, helmet, cushions, and pile installation methods and procedures based on design pile capacities and subsurface soil conditions. Allowable pile driving stresses are presented in Table 6 of this report. Care should be taken to avoid damaging piles during installation; excessive blow counts for example, can damage piles and compromise foundation support.

As adjacent piles are generally driven into progressively denser materials, some piles driven previously may heave. Pile heave is the upward movement of a pile from its originally driven elevation, and is caused by high pore pressures that build up during driving, especially in fine-grained soils. Pile heave is detrimental to pile foundation performance, and should be measured before, during and after completion of pile installation. Heave can be reduced by using the largest possible spacing between piles and by driving the piles in an appropriate sequence. Pile driving should begin at the center of the building and then proceed radially outward from the center. If significant heave occurs, the pile hammer should be replaced on the displaced pile and the pile re-driven.

Pile driving can affect existing structures and underground utilities in the vicinity of the work area and the potential impact on these facilities by pile driving should be evaluated as necessary. Structures and underground utilities located close to the pile foundations should be surveyed prior to construction and pre-existing conditions of such structures and their vicinity should be adequately recorded. This can be accomplished by conducting a pre-construction survey, taking photographs and/or video film, and documenting existing elevations, cracks, settlements, and other existing distress in the structures. The monitoring could include establishment of elevation monitoring stations, crack gauges, and inclinometers, as required. The monitoring should be performed before, periodically during, and after construction. The data should be reviewed by qualified engineers in a timely manner to evaluate the impact on existing structures and develop plans to mitigate the impact, should it be necessary.

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5.3.2 Impact of Waterline Bridge Foundation Construction on Channel Slope Stability

AEC performed an analysis to determine if equipment and stockpiles during the construction of the waterline bridge may have an impact on the short-term stability (i.e. construction phase only) of the slopes of HCFCD Unit P144-01-00 at Old Creek (N) Road. However, AEC's scope of services does not include an evaluation of the vibration impact of driving concrete piles on the stability of the channel slopes.

Design Soil Parameters and Cross Section for Slope Stability Analysis: Soil parameters used in the analyses include wet unit weights, unconsolidated-undrained (UU) shear strengths, consolidated-drained (CD) shear strengths, and consolidated-undrained (CU) shear strengths. Based on Borings B-54 and B-55, the subsurface conditions within the channel generally consist of stiff to hard lean clay to a depth of 20 feet below top of bank.

AEC analyzed the channel cross section and bridge configuration provided in TAE's 100 percent complete drawings. The design soil parameters for the cross-section slope stability analysis are presented on Plate F-1, in Appendix F.

Conditions Analyzed for Slope Stability: We used the Simplified Bishop Method of Slices option in the SLOPE/W computer program to analyze slope stability for 2-dimensional limiting equilibrium. The program has the capability to compute pore water pressures based on a defined piezometric surface. For short term (construction phase) conditions, AEC considered the groundwater depth to be equal to the groundwater levels encountered in the borings.

HCFCD requires a minimum safety factor (SF) of 1.3 for short-term conditions. Stability analyses for the channel slopes were conducted for the short-term (construction phase) condition. The short term condition models rapid construction loading taking place, so that there is no time for the induced excess pore water pressure to dissipate or for consolidation to occur during the loading period. Unconsolidated-undrained (UU) shear strength parameters were used for this analysis.

Slope Stability Analysis for Impact of Waterline Bridge Construction on HCFCD Unit P144-01-00: AEC performed analyses to determine the impact of the waterline bridge construction on the short term (construction phase) stability of HCFCD Unit P144-01-00 using the information encountered in Borings B-

54 and B-55. Design soil parameters used for the slope stability analyses are presented on Plate F-1, in Appendix F. To account for construction equipment and stockpiles, AEC considered a 300 psf construction surcharge at the top of both the north and south banks. For the short-term groundwater condition, AEC used the groundwater reading obtained from Piezometer PZ-2 (Boring B-54).

The results of the slope stability analyses for the impact of the waterline bridge construction of HCFCD Unit P144-01-00, under short-term (construction phase) condition are presented on Plates F-2 and F-3, in Appendix F. The safety factors for the channel under short-term (construction phase) conditions are in Table 7.

Table 7. Slope Stability Analysis Results at Unit P144-01-00 (Based on Borings B-54 and B-55)

Condition Analyzed	Minimum Safety Factor Short Term (Construction Phase) Condition
Waterline Bridge Construction, North Bank	6.82 (Plate F-2)
Waterline Bridge Construction, South Bank	4.60 (Plate F-3)

Based on the summary in Table 7, the resulting SF for the impact of the Old Creek (N) Road waterline bridge construction on the slopes of HCFCD Unit P144-01-00 meet HCFCD requirements for short term (construction phase) condition.

5.4 Select Fill

Select fill should be in accordance with Section 02320, Subsection 1.01.B.7 of the latest edition of the COHSCS.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

To mitigate site problems that may develop following prolonged periods of rainfall, it is essential to have adequate drainage to maintain a relatively dry and firm surface prior to starting any work at the site. Adequate drainage should be maintained throughout the construction period. Methods for controlling

surface runoff and ponding include proper site grading, berm construction around exposed areas, and installation of sump pits with pumps.

6.2 Groundwater Control

The need for groundwater control will depend on the depth of excavation relative to the groundwater depth at the time of construction. In the event that there is heavy rain prior to or during construction, the groundwater table may be higher than indicated in this report; higher seepage is also likely and may require a more extensive groundwater control program. In addition, groundwater may be pressurized in certain areas of the alignment, requiring further evaluation and consideration of the excess hydrostatic pressures.

The Contractor should be responsible for selecting, designing, constructing, maintaining, and monitoring a groundwater control system and adapt his operations to ensure the stability of the excavations. Groundwater information presented in Section 4.1 and elsewhere in this report, along with consideration for potential environmental and site variation between the time of our field exploration and construction, should be incorporated in evaluating groundwater depths. The following recommendations are intended to guide the Contractor during design and construction of the dewatering system.

In cohesive soils seepage rates are lower than in granular soils and groundwater is usually collected in sumps and channeled by gravity flow to storm sewers. If cohesive soils contain significant secondary features, seepage rates will be higher. This may require larger sumps and drainage channels, or if significant granular layers are interbedded within the cohesive soils, methods used for granular soils may be required. Where it is present, pressurized groundwater will also yield higher seepage rates.

Groundwater for excavations within saturated sands can be controlled by the installation of wellpoints. The practical maximum dewatering depth for well points is about 15 feet. When groundwater control is required below 15 feet, multiple staged wellpoint or deep wells with submersible pumps have generally proved successful. Generally, the groundwater depth should be lowered at least 5 feet below the excavation bottom in accordance with Section 01578 of the latest edition of the COHSGR.

Extended and/or excessive dewatering can result in settlement of existing structures in the vicinity; the Contractor should take the necessary precautions to minimize the effect on existing structures in the vicinity of the dewatering operation. We recommend that the Contractor verify the groundwater depths and seepage

rates prior to and during construction and retain the services of a dewatering expert (if necessary) to assist him in identifying, implementing, and monitoring the most suitable and cost-effective method of controlling groundwater.

For open cut construction in cohesive soils, the possibility of bottom heave must be considered due to the removal of the weight of excavated soil. In lean and fat clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In silty clays, heave does not typically occur unless an artificially large head of water is created through the use of impervious sheeting in bracing the cut. Guidelines for evaluating bottom stability are presented in Section 5.2.3 of this report.

6.3 Construction Monitoring

Pavement construction and subgrade preparation, as well as excavation, bedding, and backfilling of underground utilities should be monitored by qualified geotechnical professionals to check for compliance with project documents and changed conditions, if encountered. AEC should be allowed to review the design and construction plans and specifications prior to release to check that the geotechnical recommendations and design criteria presented herein are properly interpreted.

6.4 Monitoring of Existing Structures

Existing structures in the vicinity of the proposed alignment should be closely monitored prior to, during, and for a period after excavation. Several factors (including soil type and stratification, construction methods, weather conditions, other construction in the vicinity, construction personnel experience and supervision) may impact ground movement in the vicinity of the alignment. We therefore recommend that the Contractor be required to survey and adequately document the condition of existing structures in the vicinity of the proposed alignments.

7.0 LIMITATIONS

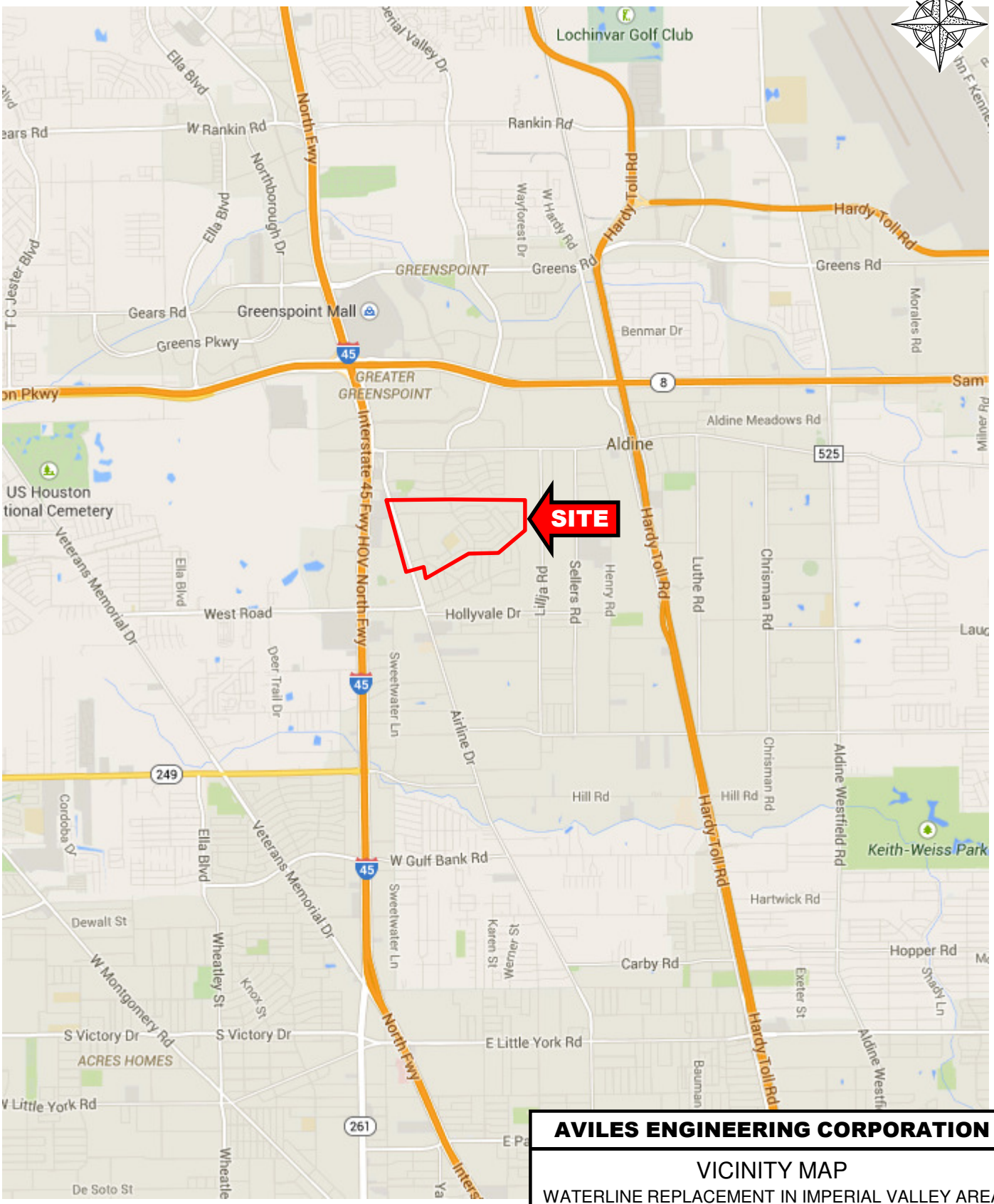
The information contained in this report summarizes conditions found on the dates the borings were drilled. The attached boring logs are true representations of the soils encountered at the specific boring locations on the dates of drilling. Reasonable variations from the subsurface information presented in this report should be anticipated. If conditions encountered during construction are significantly different from those

presented in this report; AEC should be notified immediately.

This investigation was performed using the standard level of care and diligence normally practiced by recognized geotechnical engineering firms in this area, presently performing similar services under similar circumstances. This report is intended to be used in its entirety. The report has been prepared exclusively for the project and location described in this report. If pertinent project details change or otherwise differ from those described herein, AEC should be notified immediately and retained to evaluate the effect of the changes on the recommendations presented in this report, and revise the recommendations if necessary. The recommendations presented in this report should not be used for other structures located along these alignments or similar structures located elsewhere, without additional evaluation and/or investigation.

AVILES
ENGINEERING CORP.

APPENDIX A



AVILES ENGINEERING CORPORATION

VICINITY MAP

WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, WBS NO. S-000035-0197-4
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	DWG SOURCE:
G166-14	01-23-15	GOOGLE
APPROX. SCALE:	DRAFTED BY:	PLATE NO.:
N.T.S.	WIW	PLATE A-1

AVILES ENGINEERING CORPORATION

BORING LOCATION PLAN

WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, WBS NO. S-000035-0197-4
HOUSTON, TEXAS

AEC JOB NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G166-14	01-23-15	GOOGLE MAPS
APPROX. SCALE:	DRAFTED BY:	PLATE NO.:
1" = 400'	WLW	PLATE A-2

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-1**

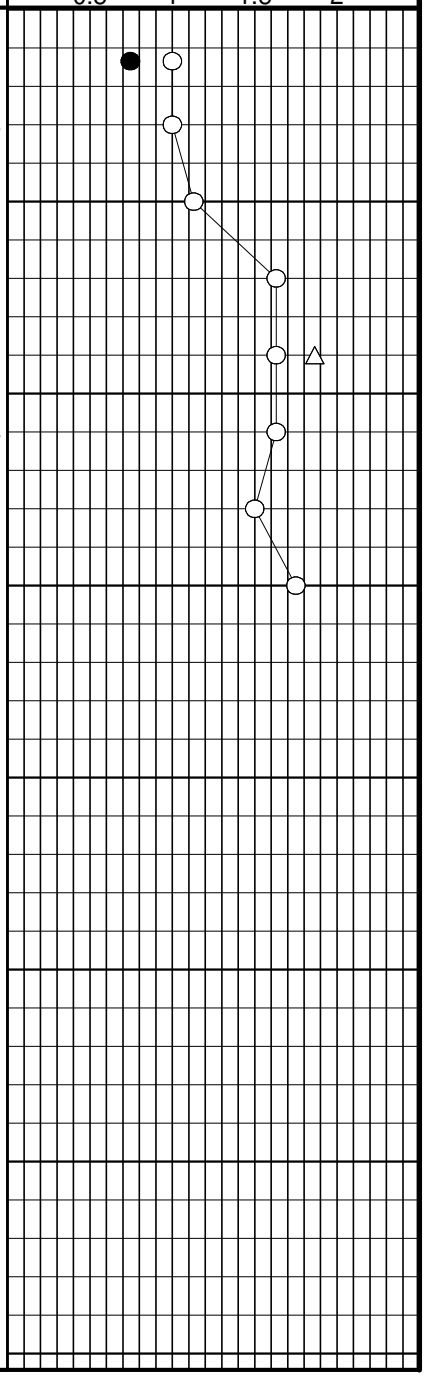
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 8.25" concrete							
		Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with silt partings			114	17			
		-light gray and tan, with ferrous nodules and siltstone fragments 2'-8'		71		17	32	16	16
80	5	-with calcareous nodules 4'-8'				17			
		-with fat clay pockets 6'-8'				16			
		Very stiff, tan and light gray Fat Clay (CH), with ferrous nodules			114	18			
75	10	-with silt pockets 8'-12'		95		23	56	22	34
		-red, brown, and light gray 12'-16', wet at 12' ▽				21			
70	15					22			
		Termination depth = 16 feet.							
65	20								
60	25								
55	30								
50	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-3**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-2**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

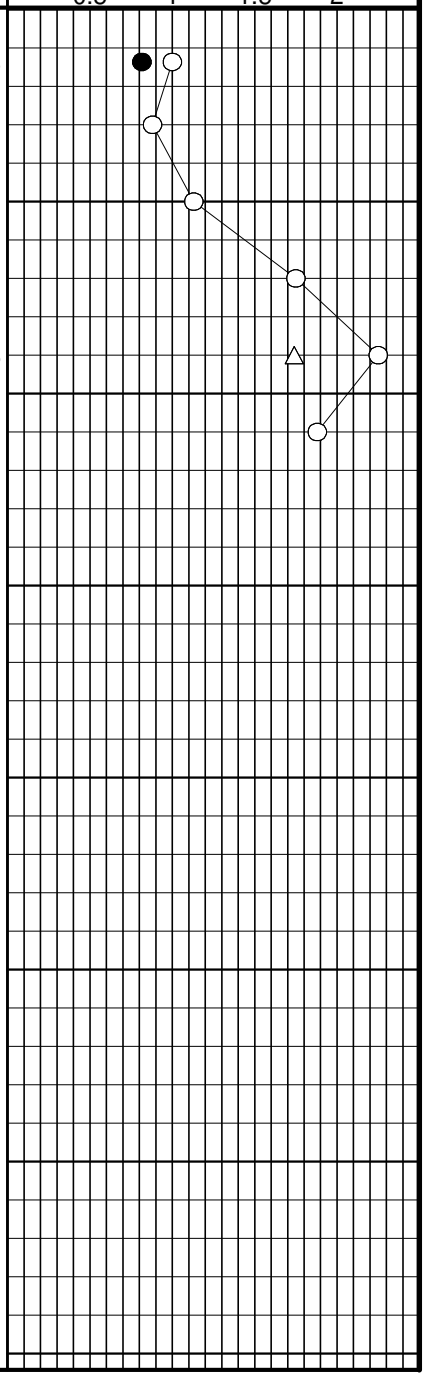
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/24/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 8.75" concrete							
80				Stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules		72	111	17	40	17	23
				-with siltstone fragments 0'-8'				19			
	5			-light gray and tan 2'-10', with calcareous nodules 2'-6'				17			
								16			
75				-with fat clay pockets 8'-12'		79	116	16	44	16	28
	10			-red, brown, and light gray, with silty clay seams 10'-12'				28			
				Termination depth = 12 feet.							
70	15										
65	20										
60	25										
55	30										
50	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-4**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-3**

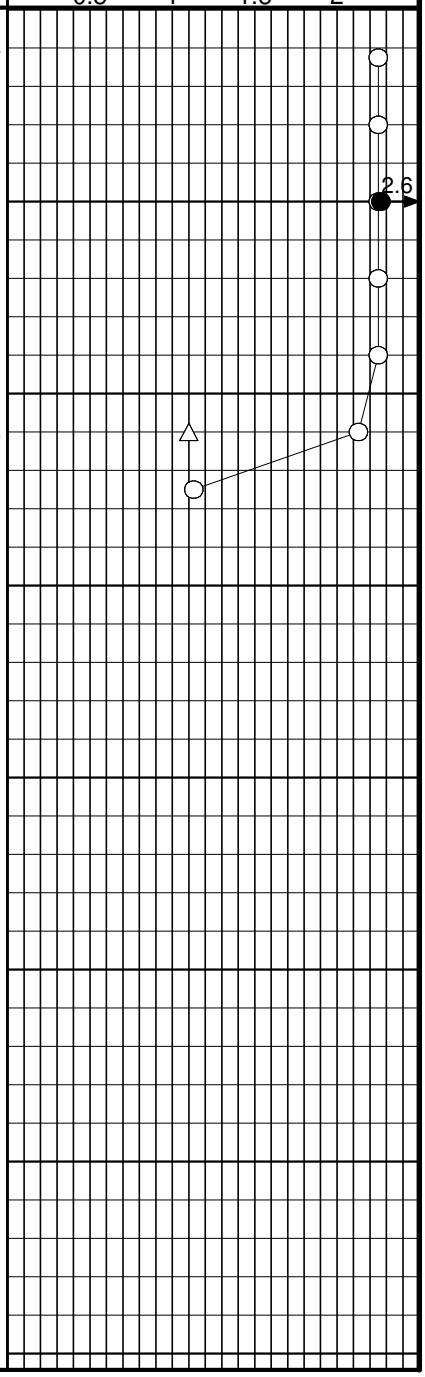
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/24/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 6" concrete							
		Hard, light gray and tan Sandy Lean Clay (CL), with silt partings, abundant siltstone fragments, calcareous and ferrous nodules		68		11	33	16	17
						9			
75	5				120	11			
						15			
		Red, brown, and light gray Clayey Sand (SC), with fat clay partings, abundant calcareous nodules and siltstone fragments -with silty clay pockets 8'-10'				20			
70	10			48	113	16	47	19	28
						29			
		Termination depth = 13 feet.							
65	15								
60	20								
55	25								
50	30								
	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-5**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-4**

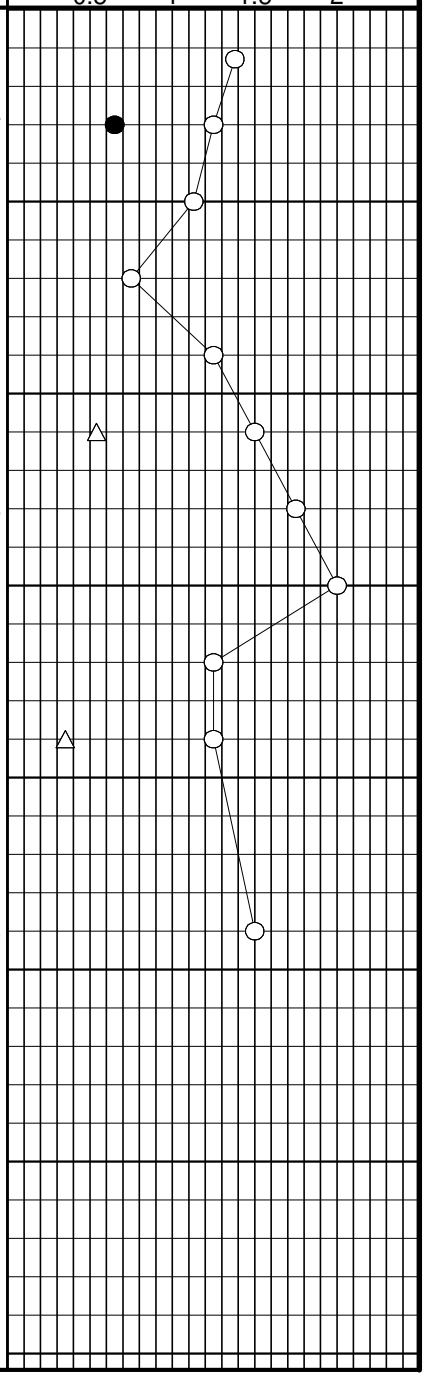
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/11/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
		Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with silt partings				18			
80		-with siltstone fragments 0'-8', and ferrous nodules 0'-2'		71	109	19	35	18	17
		-light gray 2'-4'							
	5	-with calcareous nodules 4'-10'				19			
		-tan and gray 8'-12'				23			
75						19			
	10	-with fat clay pockets and seams 10'-12'			107	20			
		Firm to very stiff, red, brown, and light gray Fat Clay (CH), with slickensides		96		26	63	25	38
70		-with vertical silt partings 14'-16'							
	15					23			
		-with silty clay seams 16'-20'							
						38			
65		-with siltstone fragments and calcareous and ferrous nodules 18'-20'			89	35			
	20								
		Very stiff, red, brown, and light gray Lean Clay w/Sand (CL), with silty clay seams, calcareous nodules, and siltstone fragments							
60				84		24	44	21	23
	25	-boring caved at 23' after drilling							
		Termination depth = 25 feet.							
55									
	30								
50									
	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **25** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **16** FEET WHILE DRILLING ▽
WATER LEVEL AT **23** FEET AFTER **COMPLETE** ▽
DRILLED BY **SolTek** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-6**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-5**

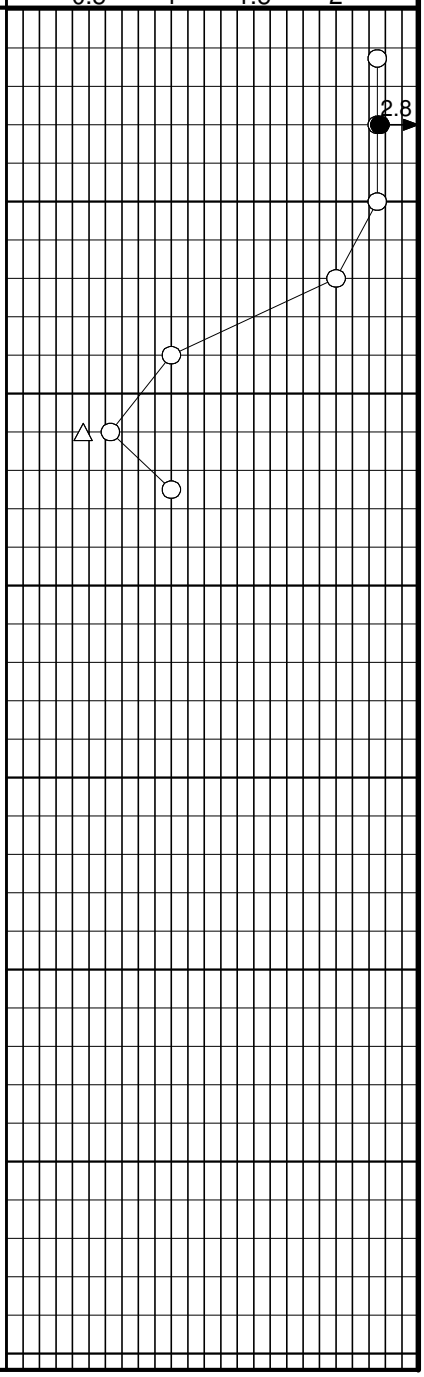
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3106964.046* *Northing: 13903213.961* *Elevation: 82.696*							
82	0			Pavement: 6.5" concrete							
				Fill: hard, dark gray Lean Clay w/Sand (CL), with silt partings, siltstone fragments, and ferrous nodules		72		13	32	15	17
80							117	13			
				Firm to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings							
	5			-with siltstone fragments and calcareous nodules 2'-6'				11			
				-with ferrous nodules 6'-8'				14			
75				-with silt pockets 8'-12'							
						76		20	40	15	25
	10						93	29			
				-red, brown, and light gray, with fat clay partings 12'-13', wet at 12'				28			
70				Termination depth = 13 feet.							
	15										
65											
	20										
60											
	25										
55											
	30										
50											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **11.7** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-7**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-6**

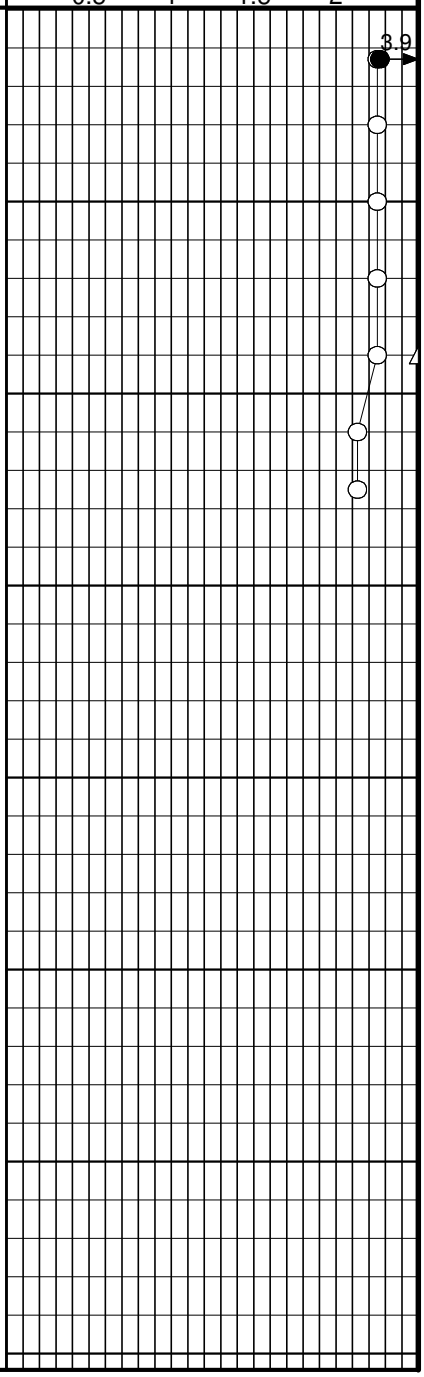
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 7" concrete							
				Hard, gray and tan Lean Clay w/Sand (CL), with silt partings, siltstone fragments, and calcareous and ferrous nodules		71	122	11	39	15	24
								10			
75	5			-with silt seams 6'-8'				8			
								12			
				Hard, red, brown, and light gray Lean Clay (CL), with slickensides and silt seams			108	22			
70	10			-with fat clay partings 10'-12'				18			
						86		17	45	18	27
				Termination depth = 13 feet.							
65	15										
60	20										
55	25										
50	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-8**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-7**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

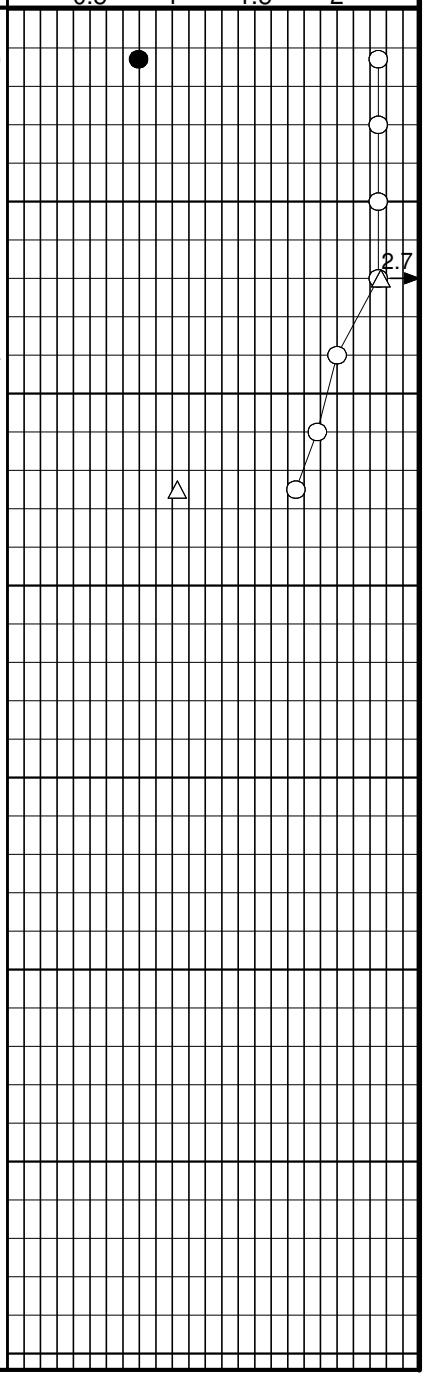
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 7" concrete							
		Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with silt partings		76	121	11	34	15	19
		-with silt pockets 0'-2'				8			
		-with abundant siltstone fragments 2'-6', and abundant calcareous nodules 2'-4'							
75	5	-with silt pockets 4'-6'				11			
		-with silt seams 6'-8'			119	14			
		Very stiff to hard, red, light gray, and tan Fat Clay (CH), with slickensides		86		21	53	19	34
70	10					25			
		-with abundant calcareous nodules and siltstone fragments 12'-13'			99	28			
		Termination depth = 13 feet.							
65	15								
60	20								
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-9

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-8**

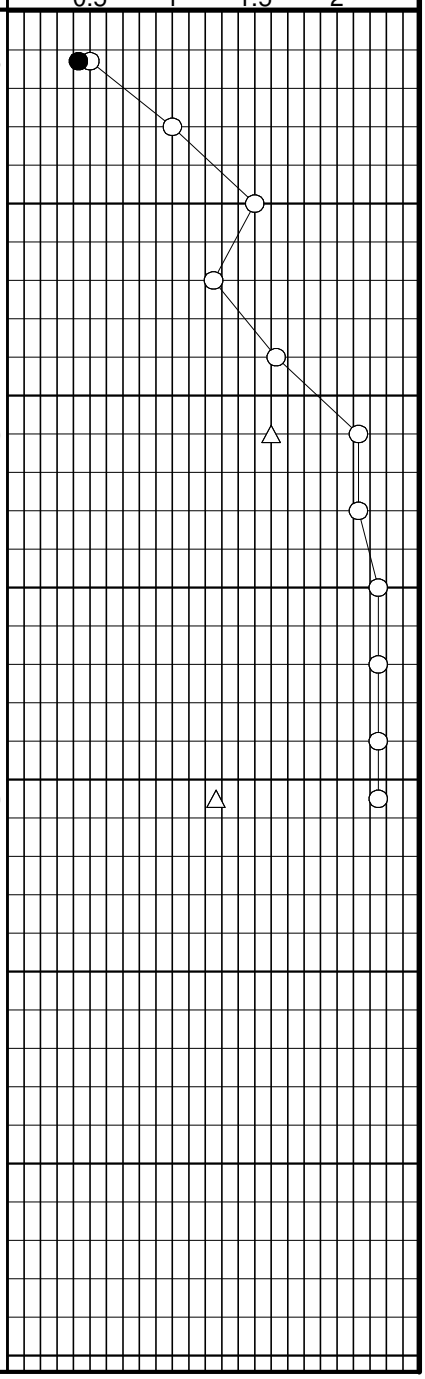
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
		Firm to very stiff, gray and tan Fat Clay w/ Sand (CH), with silt partings -with silt seams 0'-2' -with ferrous nodules 2'-8'		76	105	24	51	16	35
75	5	-with silt pockets 6'-8'				20 16 16			
		Very stiff to hard, red, brown, and light gray Lean Clay (CL), with abundant calcareous nodules and siltstone fragments				29			
70	10			89	106	21	48	18	30
		Very stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides, siltstone fragments, and calcareous nodules				25			
65	15					27			
						20			
60	20					24			
				98	108	20	52	23	29
		Termination depth = 21 feet.							
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **21** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-10**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-9**

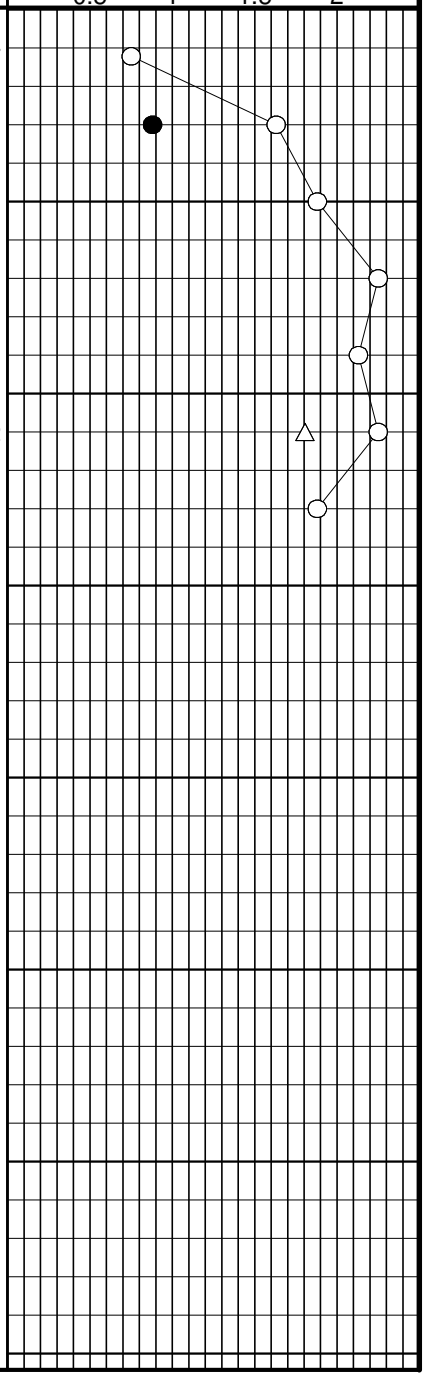
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5.25" concrete							
				Stiff to hard, tan and light gray Lean Clay w/ Sand (CL), with slickensides, silt partings, siltstone fragments, calcareous and ferrous nodules		73	125	17 10 15 17	33	16	17
75	5										
				-light gray, tan, and red, with fat clay partings 8'-14'				17			
70	10					83	108	22 25	40	18	22
65	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-11**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-10**

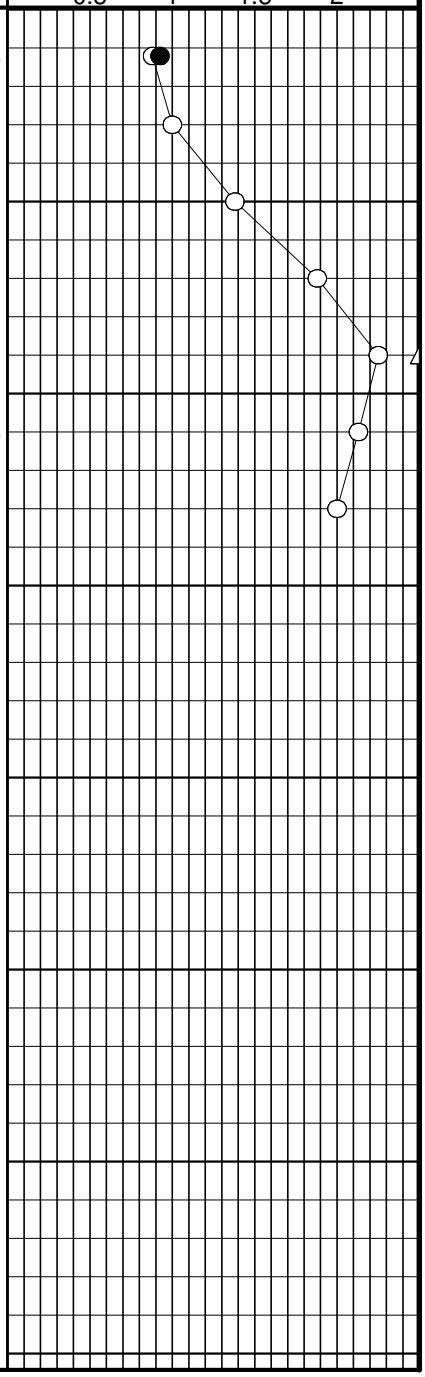
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5" concrete							
				Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with silt partings		54	117	18	34	16	18
				-with calcareous nodules and siltstone fragments 0'-4' and ferrous nodules 0'-2'				16			
75	5			-with ferrous nodules 4'-6'				16			
				Very stiff to hard, light gray and tan Fat Clay (CH)				16			
				-with silty clay seams and ferrous nodules 6'-8'			118	16			
70	10			-with silt partings 8'-10'							
						94		21	54	19	35
				-with silt partings 12'-14'				18			
65	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-12**

PROJECT: **WL Replacement in Imperial Valley Area Package II** — AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS — BORING **B-11**

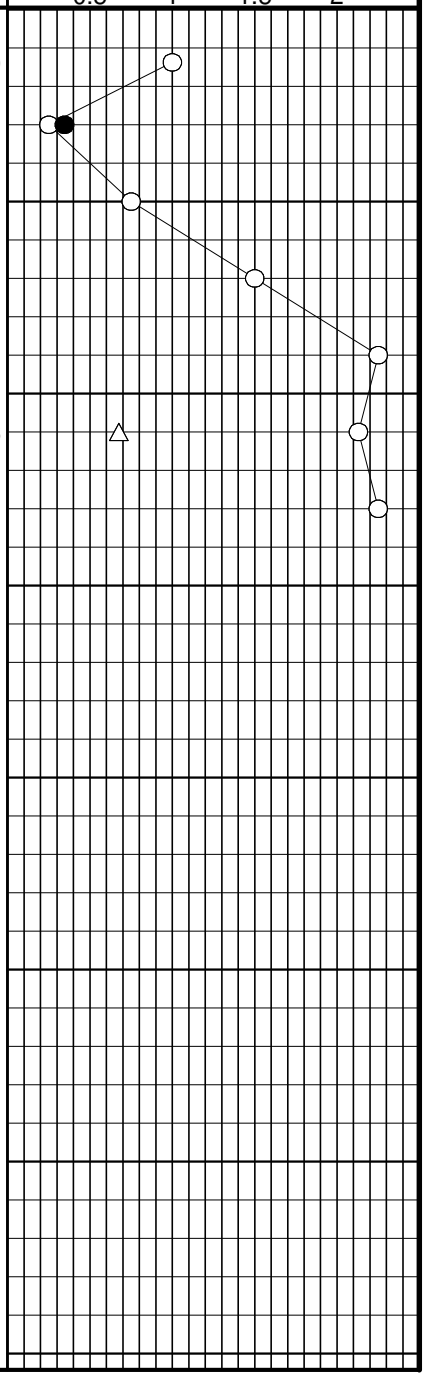
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/24/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 9" concrete							
80				Firm to very stiff, dark gray Lean Clay w/ Sand (CL), with silt partings		75		17	26	16	10
						74	106	21			
	5			-light gray and tan 4'-8', with calcareous nodules and siltstone fragments 4'-6'				20			
75								16			
				Stiff to hard, light gray and tan Lean Clay (CL), with ferrous nodules and silt partings				15			
	10					87	110	20	44	18	26
70				-with fat clay seams 12'-14'				19			
				Termination depth = 14 feet.							
	15										
65											
	20										
60											
	25										
55											
	30										
50											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3106566.527
Northing: 13902613.981
Elevation: 82.625

BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-13**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-12**

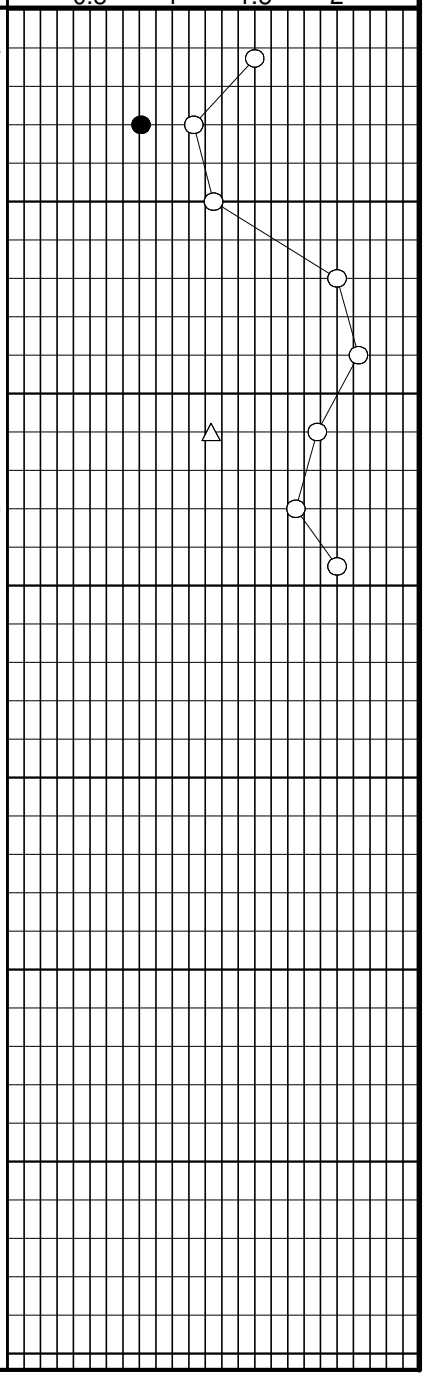
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 6.5" concrete							
				Stiff to hard, dark gray and light gray Lean Clay w/Sand (CL), with silt partings		79		17	33	16	17
				-with siltstone fragments 0'-4' and ferrous nodules 0'-2'			116	17			
75	5			-light gray and tan 2'-10', with calcareous nodules 2'-4'				16			
				-with ferrous nodules 4'-6'							
				-with fat clay pockets 6'-10'				20			
								18			
70	10			Very stiff, red, brown, and light gray Fat Clay (CH)			104	25			
						99		28	67	27	40
				-with siltstone fragments 14'-15'				26			
65	15			Termination depth = 15 feet.							
60	20										
55	25										
50	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-14**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-13**

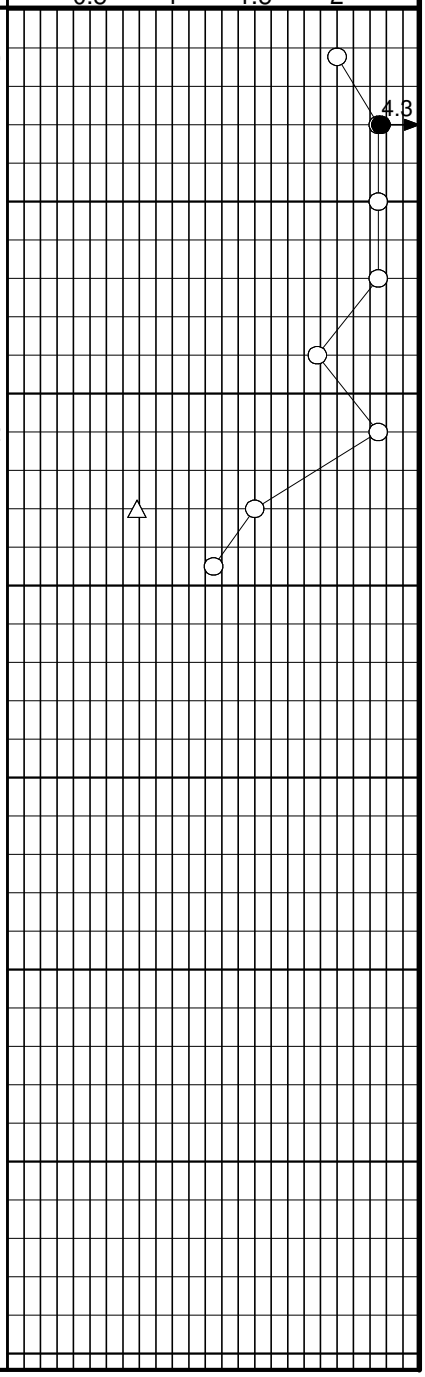
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
				Very stiff to hard, gray and tan Lean Clay w/ Sand (CL), with silt pockets and ferrous nodules		72		11	36	16	20
75	5						124	11			
								11			
								14			
70	10			Stiff to hard, tan and light gray Fat Clay (CH), with slickensides and ferrous nodules -with silt seams 8'-10' -brown, light gray, and red 10'-15'		86		19	50	18	32
								22			
							97	28			
65	15			-with silt partings 14'-15'				27			
				Termination depth = 15 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-15

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-14**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

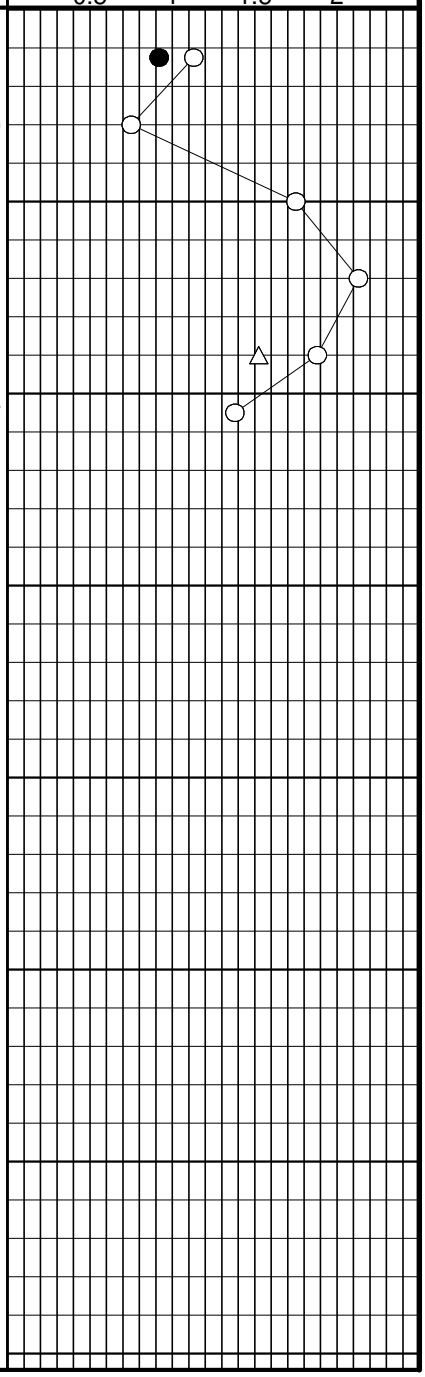
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
				Stiff to hard, gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules			115	18			
75				-with silt pockets 0'-4' and silt seams 0'-2'		74		19	46	17	29
	5			-gray and tan 2'-4', with fat clay pockets 2'-4'							
				-light gray, tan, and red 4'-10'				15			
				-with sand partings and silt seams 6'-10'				15			
70							115	16			
	10			Very stiff, red, brown, and light gray Fat Clay (CH), with calcareous nodules, silt pockets, and siltstone fragments		93		24	61	24	37
				Termination depth = 11 feet.							
65											
	15										
60											
	20										
55											
	25										
50											
	30										
45											
	35										

Survey Coordinates (TSPC, Surface):
Easting: 3108984.201
Northing: 13903256.025
Elevation: 78.702

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **11** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-16

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-15**

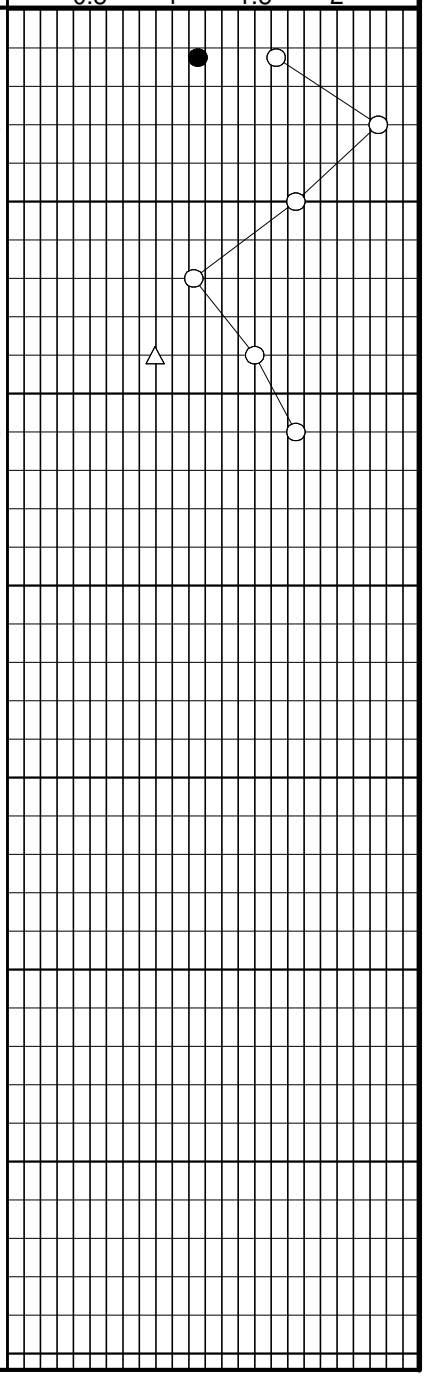
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3109491.515* *Northing: 13903321.628* *Elevation: 79.420*							
	0			Pavement: 6" concrete							
				Fill: very stiff, dark gray Lean Clay (CL), with silt partings, ferrous nodules, and siltstone fragments			117	15			
						73		15	30	17	13
75	5			Very stiff to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings, calcareous and ferrous nodules, and siltstone fragments				16			
								15			
				Stiff to very stiff, tan and light gray Lean Clay (CL), with silt partings and ferrous nodules			114	18			
70	10					89		18	47	17	30
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-17**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-16**

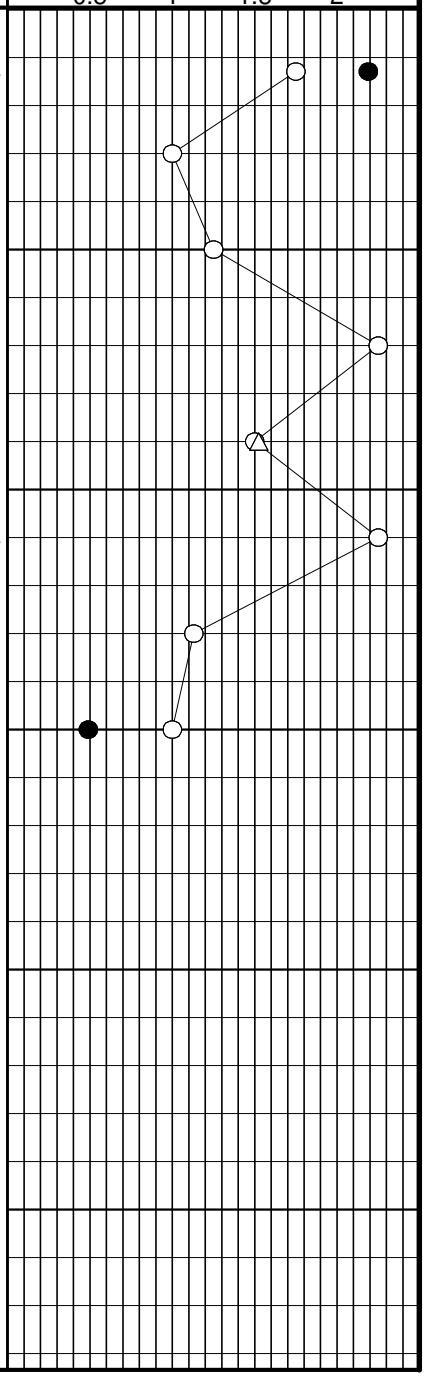
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 7" concrete							
76				Very stiff to hard, gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules		75	118	15	31	17	14
	4			-with siltstone fragments 0'-2'				18			
				-gray and tan 2'-6'				18			
72				Firm to hard, tan and light gray Sandy Lean Clay (CL), with silt partings and ferrous nodules				16			
	8			-tan, light gray, and red 8'-16'			113	18			
68				-with fat clay pockets 10'-12'		68		16	32	18	14
	12							16			
64				-with silt seams 14'-16'			113	18			
	16			Termination depth = 16 feet.							
60											
	20										
56											
	24										
52											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-18**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-17**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

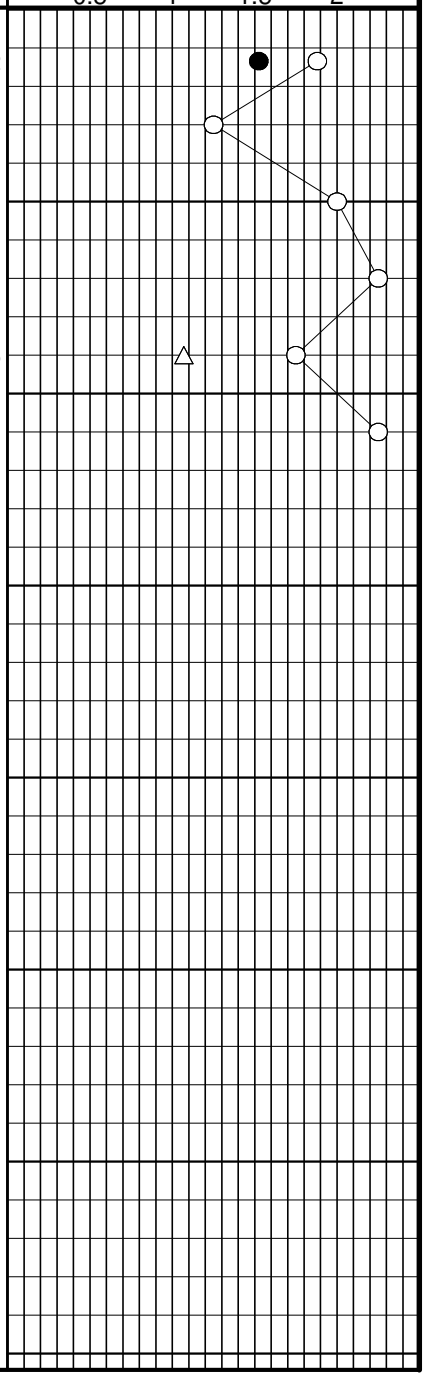
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 7.25" concrete							
75				Very stiff to hard, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings		74	121	13	28	16	12
				-with siltstone fragments and calcareous nodules 0'-4'				15			
	5			-with sand partings 4'-8'				16			
								14			
70						79	115	16	40	15	25
	10			-with fat clay pockets and silt seams 10'-12'				14			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3110294.916
Northing: 13903511.806
Elevation: 77.992

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-19

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-18**

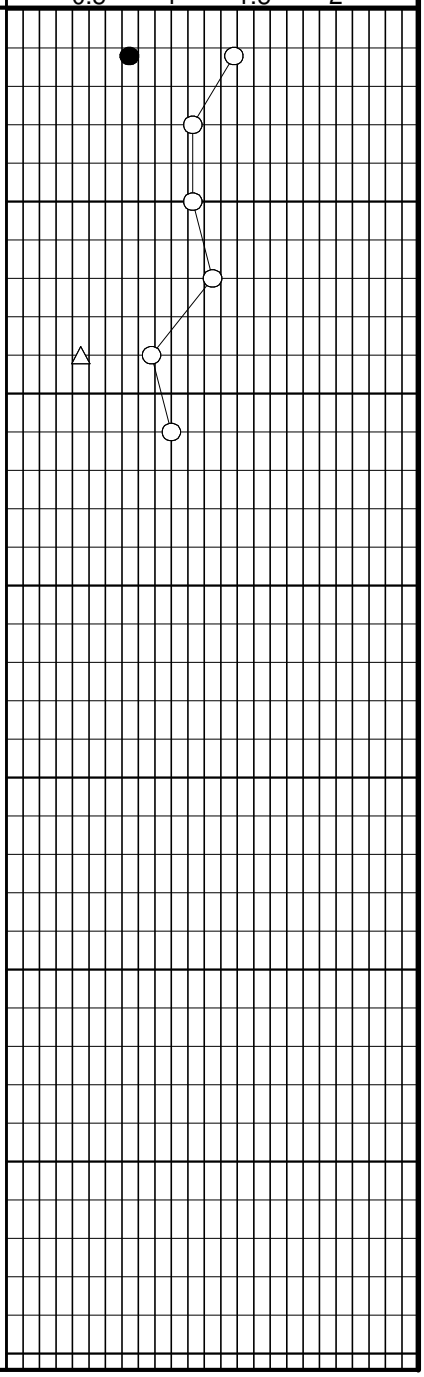
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/17/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 5" concrete							
75		Stiff to very stiff, tan and light gray Sandy Lean Clay (CL), with silt partings and ferrous nodules		54	117	12	29	18	11
	5	-with abundant siltstone fragments and calcaerous noudles 0'-2'				17			
70						17			
						18			
	10	Firm to very stiff, light gray and tan Lean Clay w/Sand (CL), with silt partings		80	109	19	29	15	14
		-with silt seams 8'-10'				22			
65		Termination depth = 12 feet.							
	15								
60									
	20								
55									
	25								
50									
	30								
45									
	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-20**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-19**

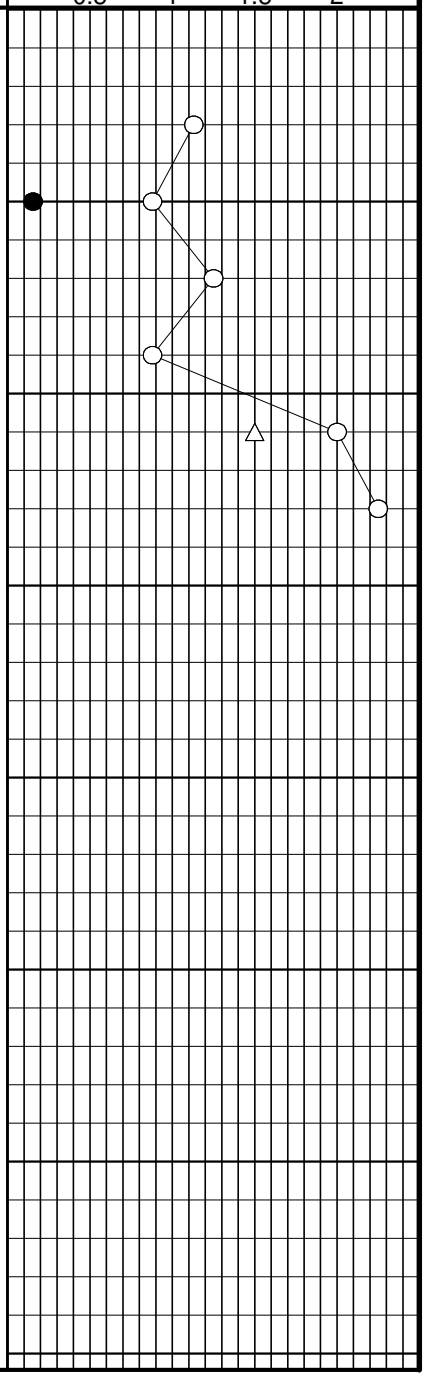
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/24/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3106726.799* *Northing: 13902169.272* *Elevation: 82.923*							
82	0			Pavement: 9" concrete							
				Base: 15" lime-stabilized clayey sand				16			
80				Fill: dark gray Silty Clayey Sand (SC-SM), with shell and ferrous nodules		21		11	31	24	7
	5			Soft to very stiff, dark gray Lean Clay w/ Sand (CL), with silt partings and ferrous nodules		74	101	22			
75				-with calcareous nodules and siltstone fragments 4'-8'				17			
				-tan and light gray 6'-10'				20			
	10			Very stiff to hard, tan and light gray Lean Clay (CL), with fat clay pockets, silt partings, and ferrous nodules		91	105	24	48	17	31
70				-red, brown, and light gray 12'-14'				19			
				Termination depth = 14 feet.							
65	15										
	20										
60											
	25										
55											
	30										
50											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **8** FEET WHILE DRILLING ▽
WATER LEVEL AT **12.7** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-21**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-20**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

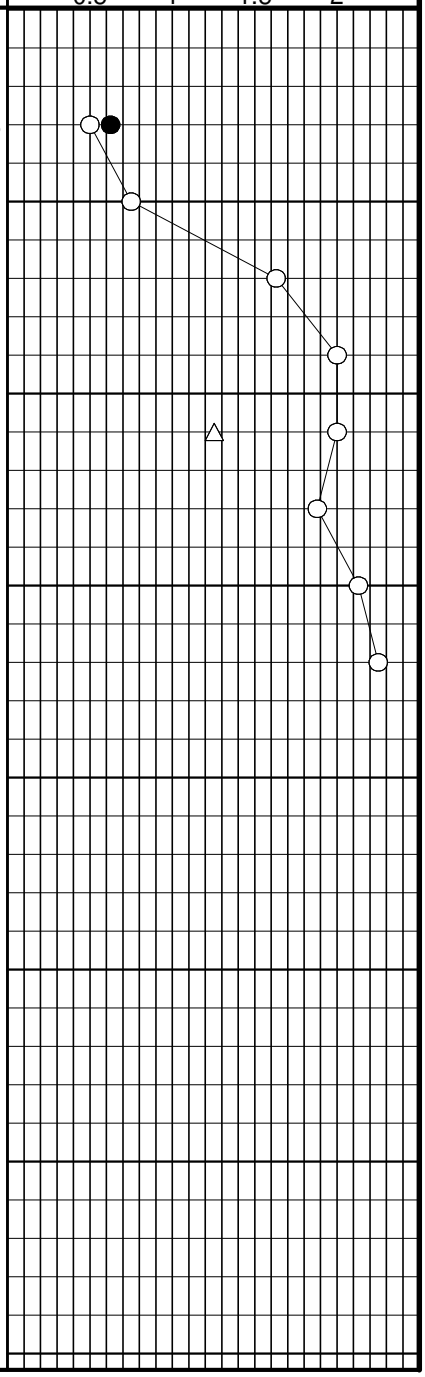
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 7" concrete							
		Base: 15" lime-stabilized clay							
		Firm to very stiff, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules		78	113	22 19	34	16	18
75	5					18 16			
		Very stiff to hard, brown, light gray, and tan Fat Clay (CH), with slickensides and calcareous nodules -with silt pockets 8'-10' -red, brown, and light gray, with abundant siltstone fragments 10'-18'				19			
70	10				105	21			
				96		21	63	22	41
65	15					24 21			
		Termination depth = 18 feet.							
60	20								
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-22**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-21**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

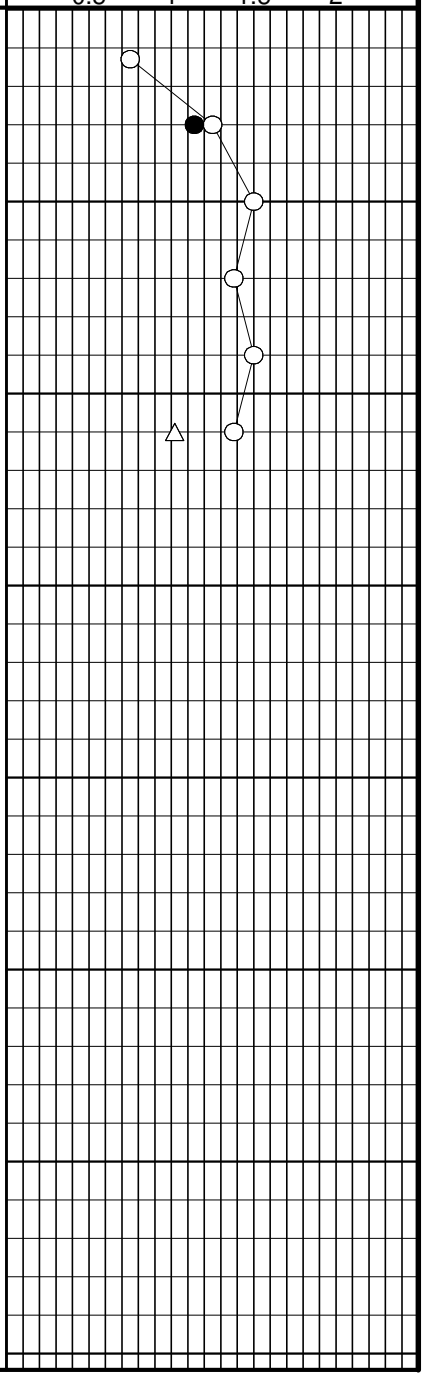
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3108361.334* *Northing: 13902391.216* *Elevation: 79.955*							
	0			Pavement: 7" concrete							
				Fill: stiff, dark gray Lean Clay w/Sand (CL), with silt partings, ferrous and calcareous nodules		75		22	45	16	29
							111	19			
				Very stiff, gray and tan Lean Clay w/Sand (CL), with silt seams and ferrous nodules							
75	5							19			
				-light gray, tan, and red, with silt pockets 6'-8'				17			
						80		17	42	16	26
70	10						112	19			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-23

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-22**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

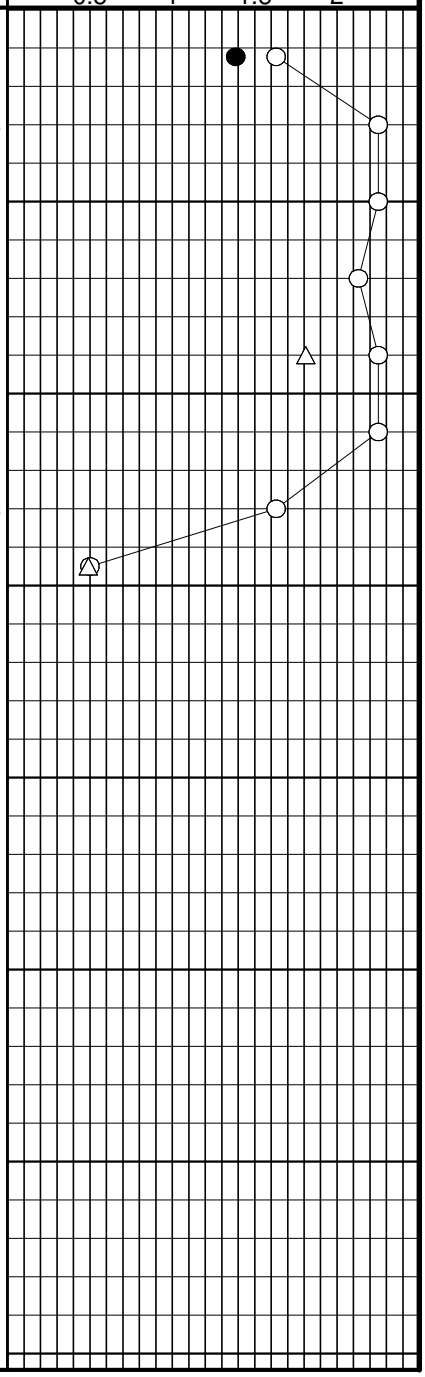
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
				Very stiff to hard, gray and tan Lean Clay w/ Sand (CL), with silt pockets			119	15			
						79		12	39	14	25
75	5			-with ferrous nodules 4'-8'				10			
								13			
				Firm to hard, tan, red, and light gray Lean Clay (CL)			118	15			
70	10			-with ferrous nodules 8'-14', and silt seams 8'-12'				18			
				-red, brown, and light gray 10'-15'							
						90		25	45	19	26
65	15						110	16			
				Termination depth = 15 feet.							
60	20										
55	25										
50	30										
45	35										

Survey Coordinates (TSPC, Surface):
Easting: 3108759.802
Northing: 13902731.715
Elevation: 78.906

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-24

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-23**

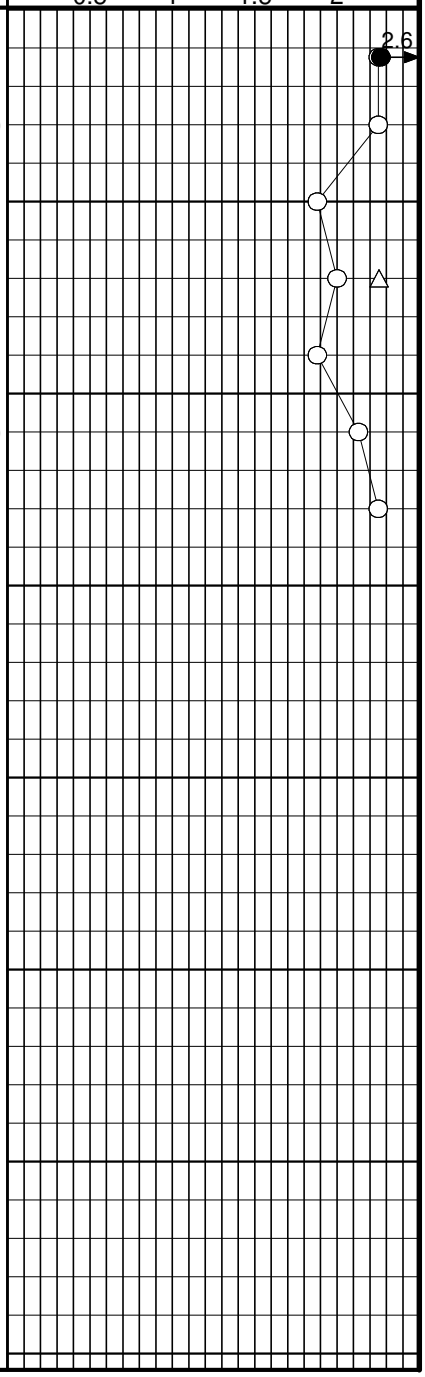
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5.75" concrete							
				Very stiff to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings, siltstone fragments and calcareous nodules			122	13			
75				-with ferrous nodules 2'-8'		76		12	34	15	19
	5							14			
							118	16			
70				Very stiff to hard, tan and light gray Lean Clay (CL), with silt pockets				17			
	10					86		19	46	16	30
				-with siltstone fragments 12'-14'				19			
65											
	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-25**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-24**

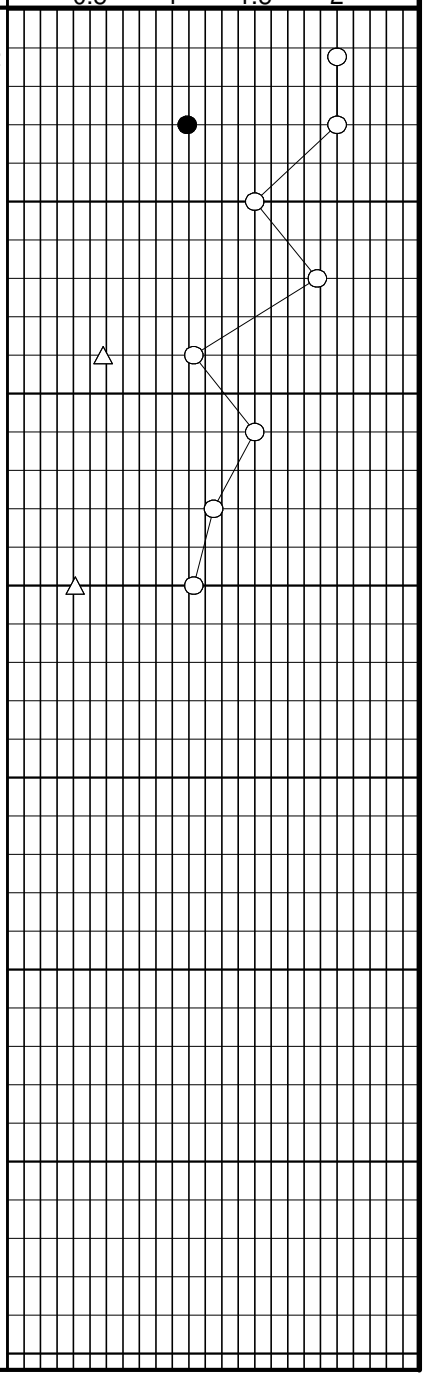
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
				Stiff to very stiff, light gray and dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules		76		14	27	15	12
				-with abundant calcareous nodules 0'-4' and siltstone fragments 0'-8'			119	14			
75	5							16			
								16			
70	10			-with fat clay pockets 10'-12'		79	114	19	37	16	21
								19			
				Light gray and tan Silty Clayey Sand (SC-SM)				19			
65	15					38	112	17	28	22	6
				Termination depth = 16 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3109631.181
Northing: 13903057.384
Elevation: 79.288

BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-26**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-25**

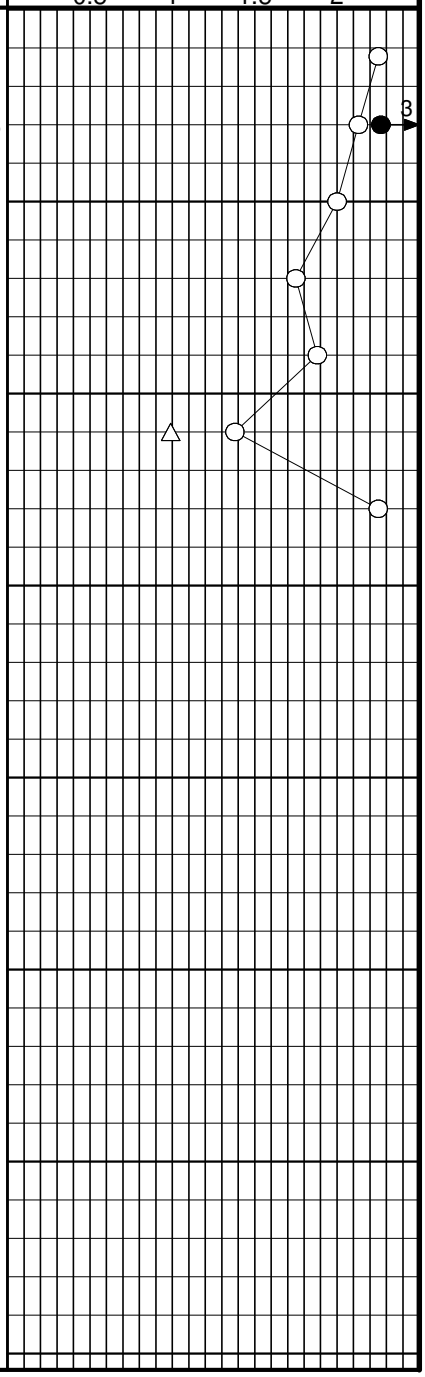
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3110233.011* *Northing: 13903111.252* *Elevation: 77.877*							
77.9	0			Pavement: 5.25" concrete							
				Hard, dark gray Fat Clay (CH), with sand partings and silt pockets -with ferrous nodules 0'-2'				16			
75						90	108	20	53	17	36
	5			Stiff to hard, light gray and tan Lean Clay w/ Sand (CL), with silt partings and siltstone fragments -with abundant calcareous and ferrous nodules 4'-10'				22			
70								18			
	10			-light gray, tan, and red 10'-14'				18			
						85	107	20	39	18	21
65								19			
	15			Termination depth = 14 feet.							
60											
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-27**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-26**

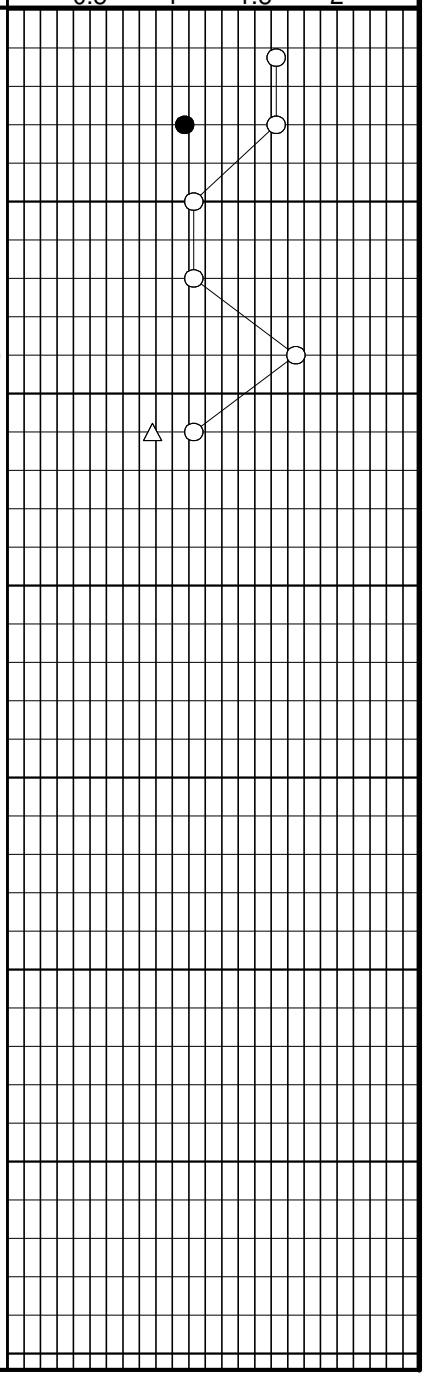
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
75				Very stiff, light gray Sandy Lean Clay (CL), with silt partings, ferrous nodules, and siltstone fragments		66		14	27	18	9
	5			-with abundant calcareous nodules 0'-4'			118	13			
				-light gray and tan 2'-8'				16			
								16			
70				Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with silt partings		78		17	45	16	29
	10			-with ferrous nodules 8'-10'							
				-with silt seams, calcareous nodules, and siltstone fragments 10'-12'			113	17			
65				Termination depth = 12 feet.							
	15										
60											
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3110827.212
Northing: 13903399.448
Elevation: 78.199

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-28**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-27**

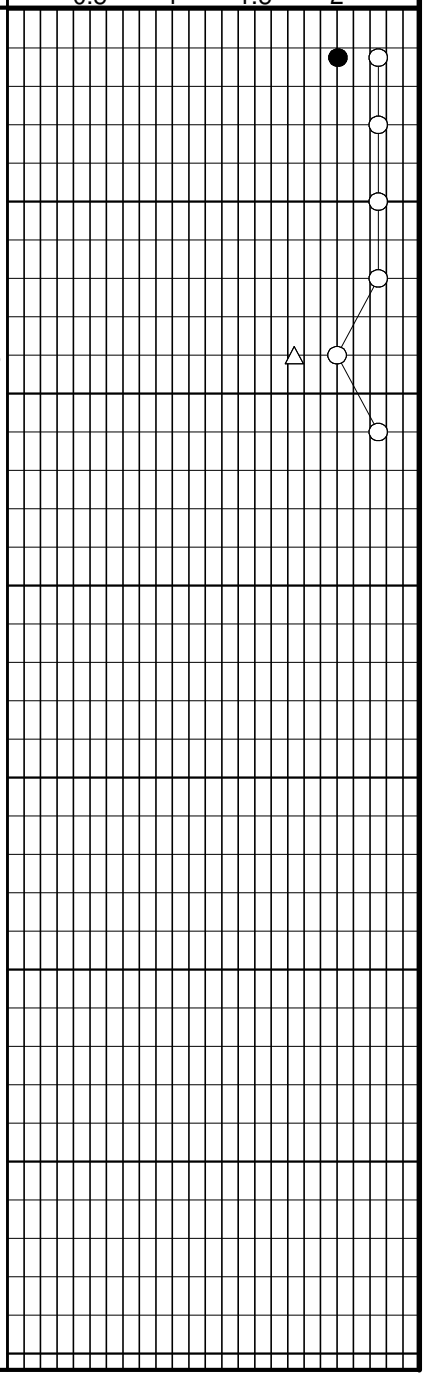
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 6" concrete							
				Fill: hard, light gray and tan Lean Clay (CL), with silt partings, ferrous and calcareous nodules, and siltstone fragments			119	15			
						66		9	26	15	11
75	5			Hard, light gray and tan Sandy Lean Clay (CL), with silt partings, ferrous and calcareous nodules, and siltstone fragments				12			
				Very stiff to hard, tan and light gray Lean Clay w/Sand (CL) -with ferrous nodules 6'-8' -with calcareous nodules and siltstone fragments 8'-12'				13			
70	10					78	116	16	43	15	28
								16			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-29**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-28**

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3109459.194* *Northing: 13902780.504* *Elevation: 78.318*							
80	0			Pavement: 6" concrete							
				Very stiff to hard, gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings			120	14			
75				-with siltstone fragments 0'-4' -gray and tan 2'-10'		74		12	30	15	15
	5							10			
							114	16			
70						80		16	44	17	27
	10			-light gray and red, with silt pockets and fat clay partings 10'-12'				20			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2 3.0

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-30**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-29**

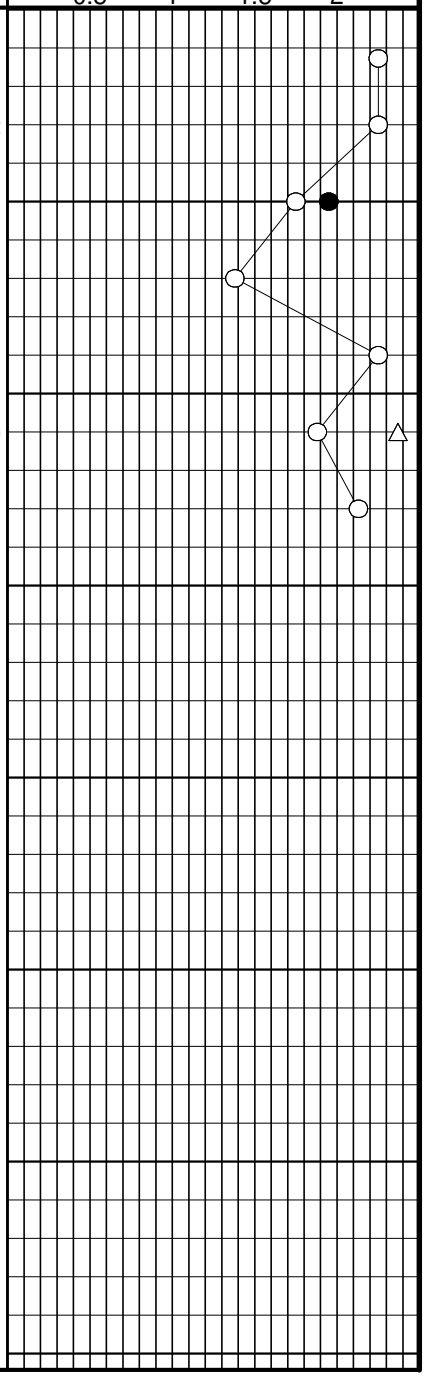
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6.5" concrete				12			
75				Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with siltstone fragments, silt partings, and ferrous and calcareous nodules		68		12	27	15	12
	5						118	14			
				Very stiff to hard, tan and light gray Lean Clay (CL), with slickensides, silt partings, and ferrous nodules -with fat clay pockets 8'-10'				18			
70								15			
	10					91	114	16	49	19	30
65								19			
				Termination depth = 14 feet.							
60	15										
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-31**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-30**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

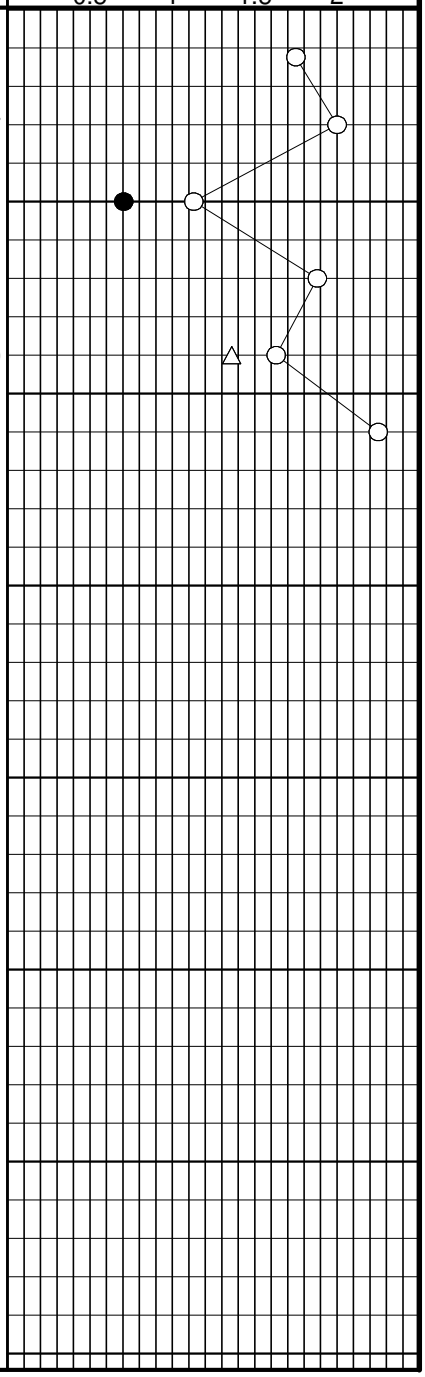
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 5.75" concrete							
75		Light gray and dark gray Clayey Sand (SC), with abundant calcareous and ferrous nodules, silt partings, and siltstone fragments		44		15 12	33	16	17
	5	Stiff to hard, light gray Lean Clay (CL), with silt partings -with ferrous nodules 4'-8'			112	18 17			
70		-brown, light gray and tan 8'-12', with abundant calcareous nodules and siltstone fragments		89	111	19 12	44	15	29
	10								
65		Termination depth = 12 feet.							
	15								
60									
	20								
55									
	25								
50									
	30								
45									
	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3110649.259
Northing: 13903113.226
Elevation: 77.030

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-32

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-31**

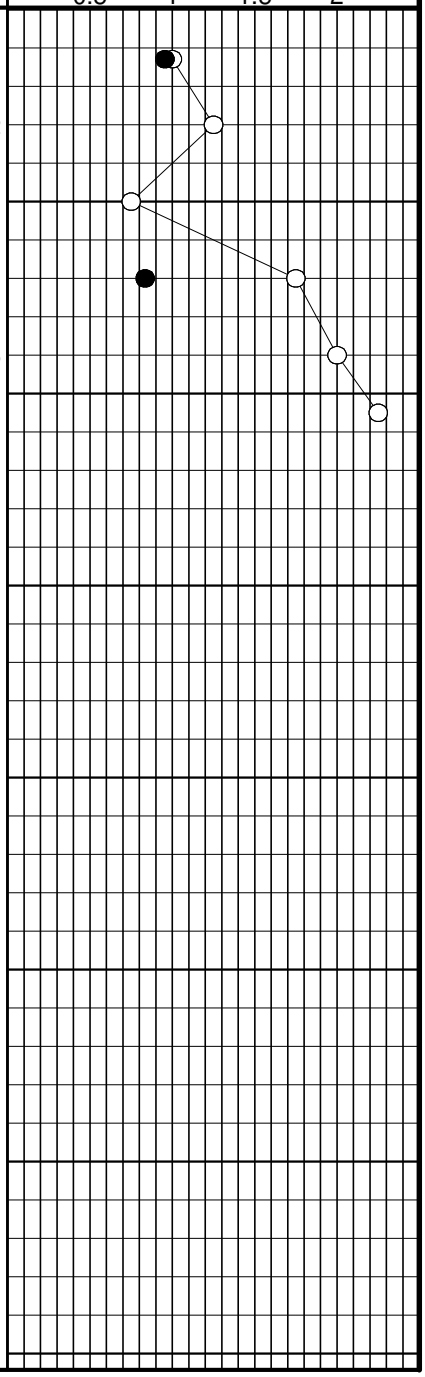
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/20/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
75	0			Pavement: 7" concrete							
				Stiff to very stiff, dark gray and light gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings			121	12			
				-with siltstone fragments and calcareous nodules 0'-2'		78		17	28	16	12
	5			-light gray 2'-6'				16			
70				Stiff to hard, light gray and tan Lean Clay (CL), with ferrous nodules			113	17			
				-with silt partings, calcareous nodules, and siltstone fragments 6'-8'		86		14	40	15	25
	10			-with silt pockets, calcareous nodules, and siltstone fragments				15			
65				Termination depth = 11 feet.							
60	15										
55	20										
50	25										
45	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3111131.982
Northing: 13903108.57
Elevation: 76.680

BORING DRILLED TO **11** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-32**

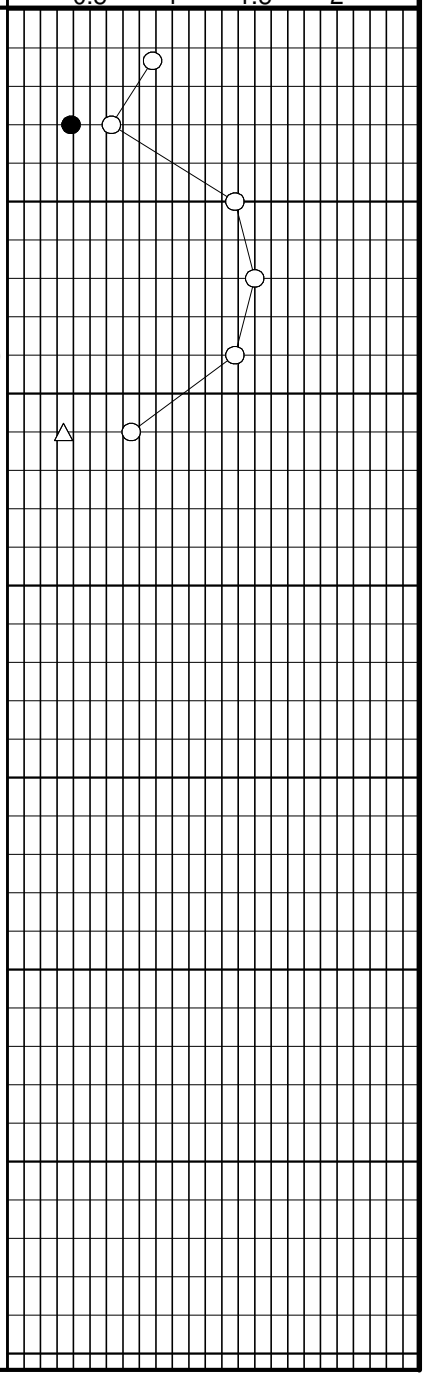
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/24/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3106884.187* *Northing: 13901704.837* *Elevation: 81.526*							
80	0			Pavement: 8" concrete							
				Firm to very stiff, dark gray Silty Clay w/ Sand (CL-ML), with silt seams				14			
				-with vertical silt seams 2'-4'		75	109	17	24	17	7
	5			-tan and gray 4'-6'				17			
75				Firm to very stiff, light gray and tan Lean Clay w/Sand (CL), with silt partings				16			
				-with ferrous nodules 6'-8'							
				-with siltstone fragments 8'-10'		73		17	27	17	10
	10						102	23			
70				Termination depth = 12 feet.							
	15										
65											
	20										
60											
	25										
55											
	30										
50											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-34**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-33**

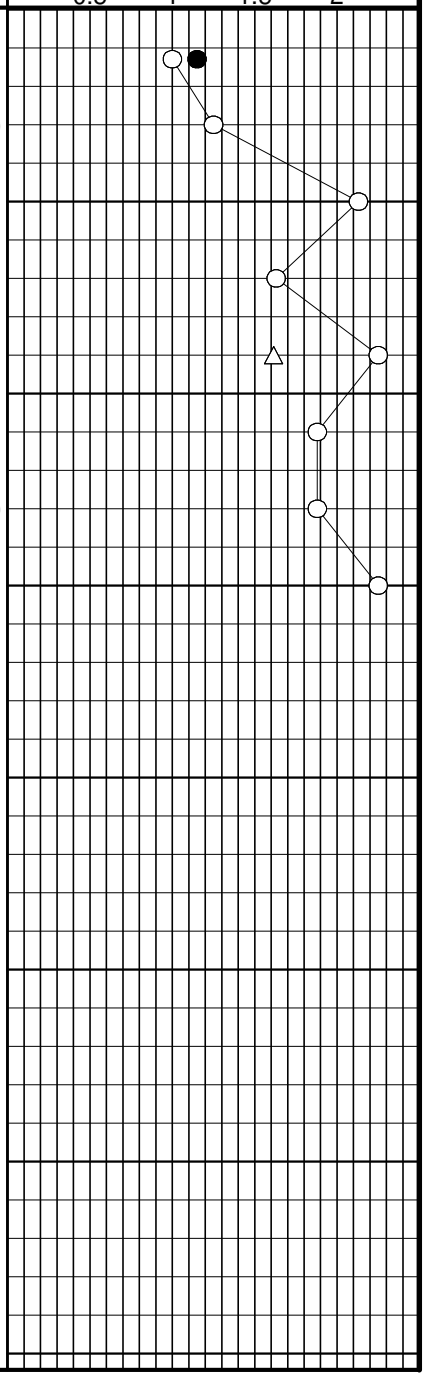
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 7" concrete							
				Stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings			114	18			
				-dark gray and dark brown, with silt pockets 2'-4'		70		19	47	17	30
75	5			-light gray, tan, and red 4'-10'				16			
				-with silt pockets and ferrous nodules 6'-10'				16			
				Very stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides, silt pockets, and ferrous nodules			113	19			
70	10							24			
				-with abundant calcareous nodules and siltstone fragments 12'-14'		95		20	61	22	39
65	15							21			
				Termination depth = 16 feet.							
60	20										
55	25										
50	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-35**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-34**

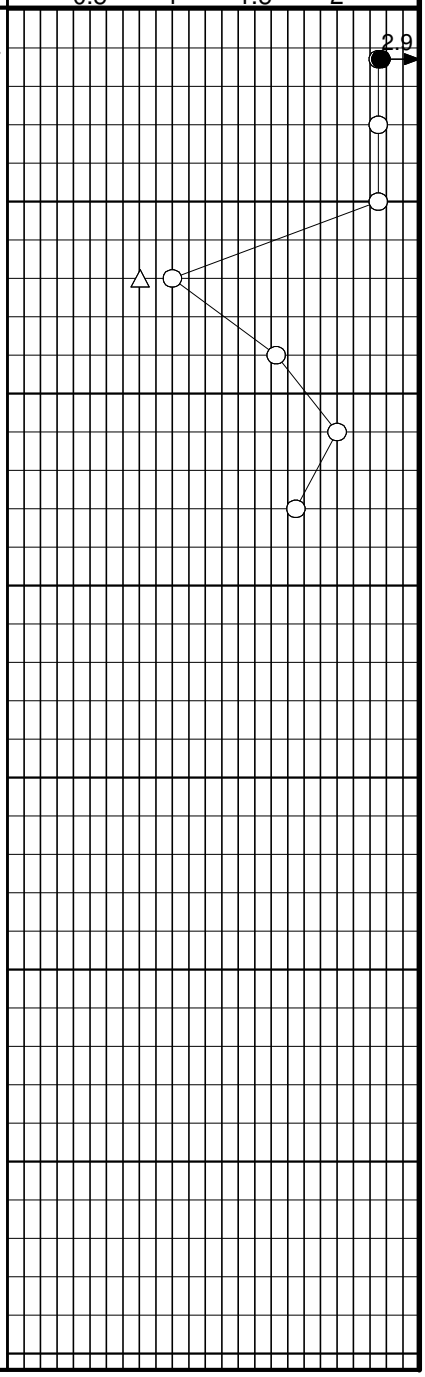
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3108316.194							
				Northing: 13902030.16							
				Elevation: 79.649							
75	0			Pavement: 7" concrete							
				Hard, light gray Sandy Lean Clay (CL), with calcareous and ferrous nodules, silt partings, and siltstone fragments		62	123	9	33	16	17
	5			-light gray and tan 2'-6'				9			
								10			
				Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with slickensides and ferrous nodules			112	17			
70	10			-with silt partings 6'-10'		73		18	47	16	31
				-with silt pockets and seams 8'-10'							
				-red, brown, and light gray 10'-14'				17			
				-with silt pockets 12'-14'				22			
65	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-36**

PROJECT: **WL Replacement in Imperial Valley Area Package II** — AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS — BORING **B-35**

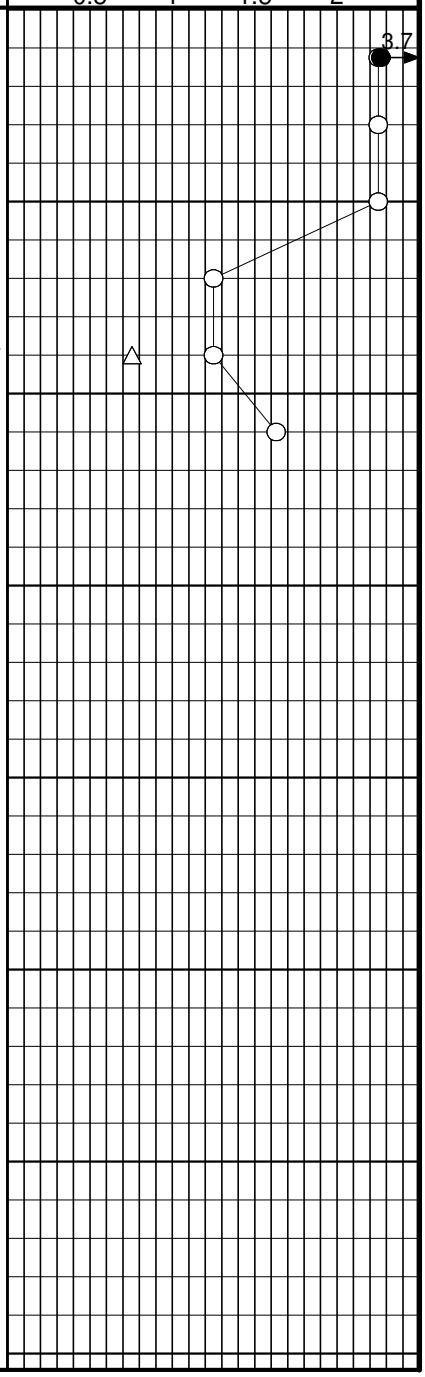
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
				Hard, light gray and tan Sandy Lean Clay (CL), with silt partings, calcareous and ferrous nodules, and siltstone fragments		60	126	9	29	18	11
75	5							8			
								12			
				Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules				15			
				-with calcareous nodules and siltstone fragments 6'-8'		74	112	18	41	14	27
70	10			-with silty clay pockets and siltstone fragments 10'-12'				14			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-37**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-36**

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

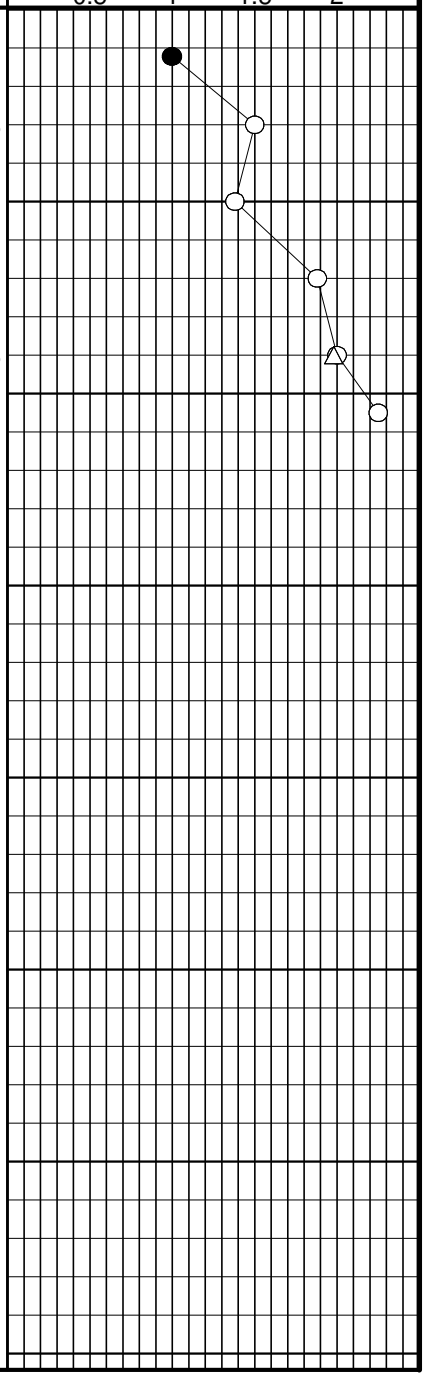
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.25" concrete							
				Stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings			117	15			
75				-with silt pockets 0'-2'		83		18	43	15	28
	5			-light gray and tan 4'-12', with ferrous nodules 4'-10'				18			
								18			
70				-with fat clay pockets 8'-12'		85	115	17	43	15	28
	10			-with silt pockets 10'-11'				19			
				Termination depth = 11 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

Survey Coordinates (TSPC, Surface):
Easting: 3109572.162
Northing: 13902513.534
Elevation: 78.705

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **11** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-38**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-37**

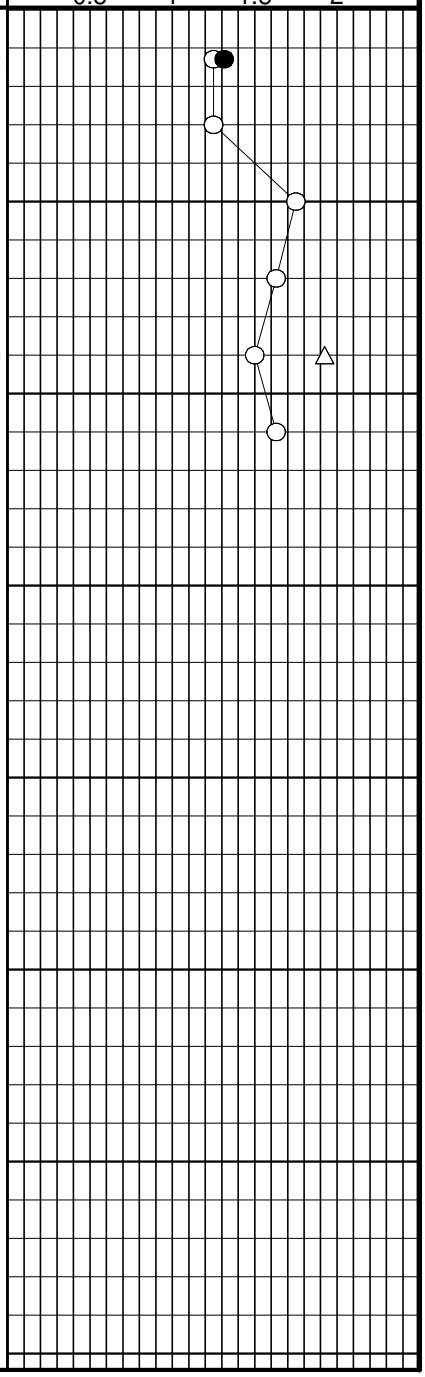
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3110077.427* *Northing: 13902651.145* *Elevation: 78.436*							
78	0			Pavement: 7" concrete							
				Very stiff, light gray and tan Sandy Lean Clay (CL), with silt partings, calcareous nodules, and siltstone fragments -with ferrous nodules 2'-6'		64	120	14	29	17	12
75								15			
	5							15			
				Very stiff, light gray and tan Lean Clay w/ Sand (CL), with calcareous and ferrous nodules, silt partings, and siltstone fragments				16			
70						79	114	18	46	16	30
	10			-light gray, red, and tan, with silt pockets 10'-12'				24			
				Termination depth = 12 feet.							
65	15										
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-39**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-38**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

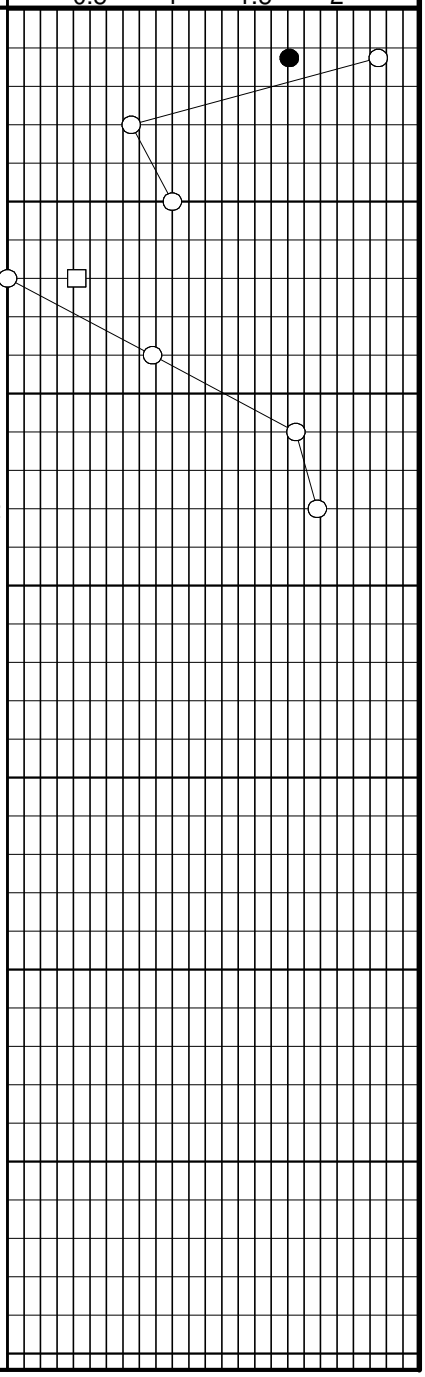
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 6.25" concrete							
		Stiff to hard, light gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules			121	14			
				79		17	25	17	8
75	5	Very soft to very stiff, light gray Sandy Silty Clay (CL-ML), with ferrous nodules				18			
		-with siltstone fragments 6'-10'		68		21	22	18	4
						20			
70	10	Very stiff, red, brown, and light gray Fat Clay (CH), with slickensides, silt pockets, and ferrous nodules				18			
		-with silt seams 12'-14'		87		26	51	19	32
		Termination depth = 14 feet.							
65	15								
60	20								
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-40

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-39**

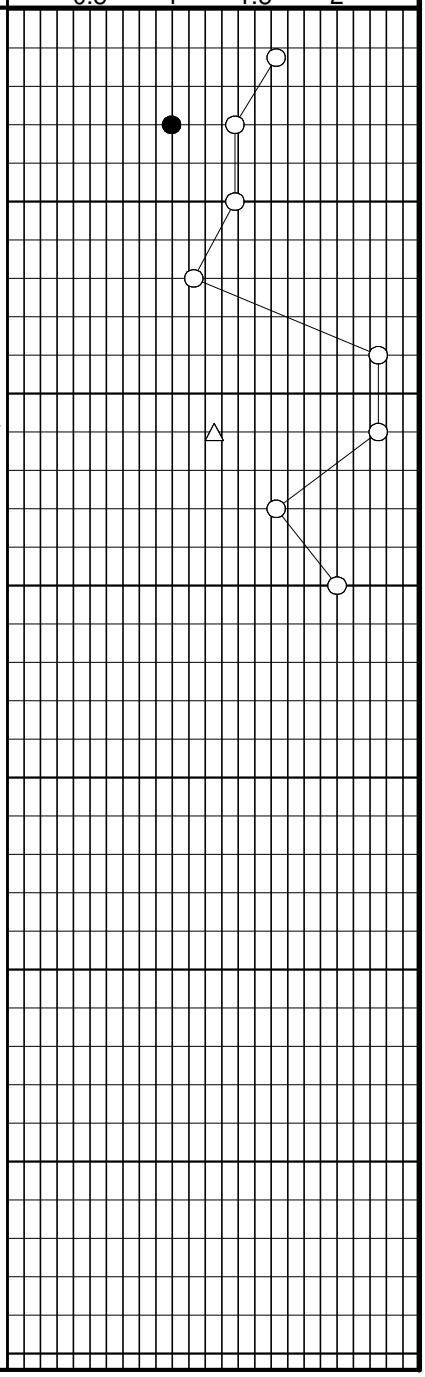
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
				Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with ferrous nodules and silt partings		73		15	26	18	8
75				-with siltstone fragments 0'-4'			117	14			
	5			-with silt pockets 6'-8'				16			
				-with fat clay seams 8'-10'				17			
70								17			
	10			Very stiff to hard, red, brown, and light gray Fat Clay (CH), with silt pockets		90	112	19	58	21	37
65				-with abundant calcareous nodules and siltstone fragments 14'-16'				16			
	15							19			
				Termination depth = 16 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-41**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-40**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

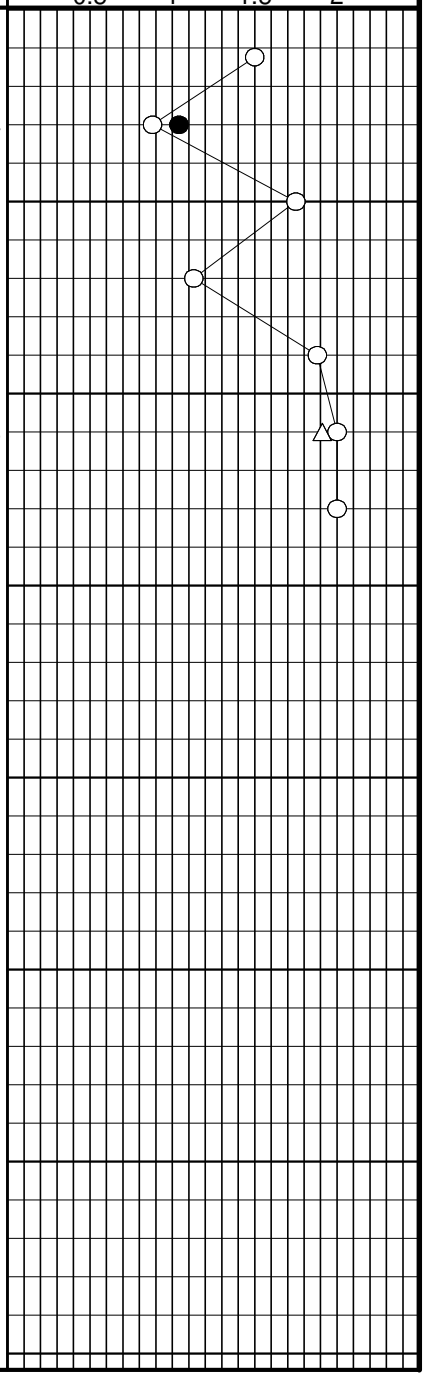
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/18/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3108216.388* *Northing: 13901693.969* *Elevation: 78.984*							
80	0			Pavement: 5.75" concrete							
				Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with silt partings and ferrous nodules				15			
75	5			-tan and light gray 2'-8'		77	113	18	30	16	14
								15			
								17			
70	10			Very stiff, tan and light gray Fat Clay (CH), with slickensides				18			
				-with silt seams and ferrous nodules 8'-10' -red, brown, and light gray 10'-14', with silt pockets 10'-12'		91	107	22	53	20	33
								21			
65	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-42

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-41**

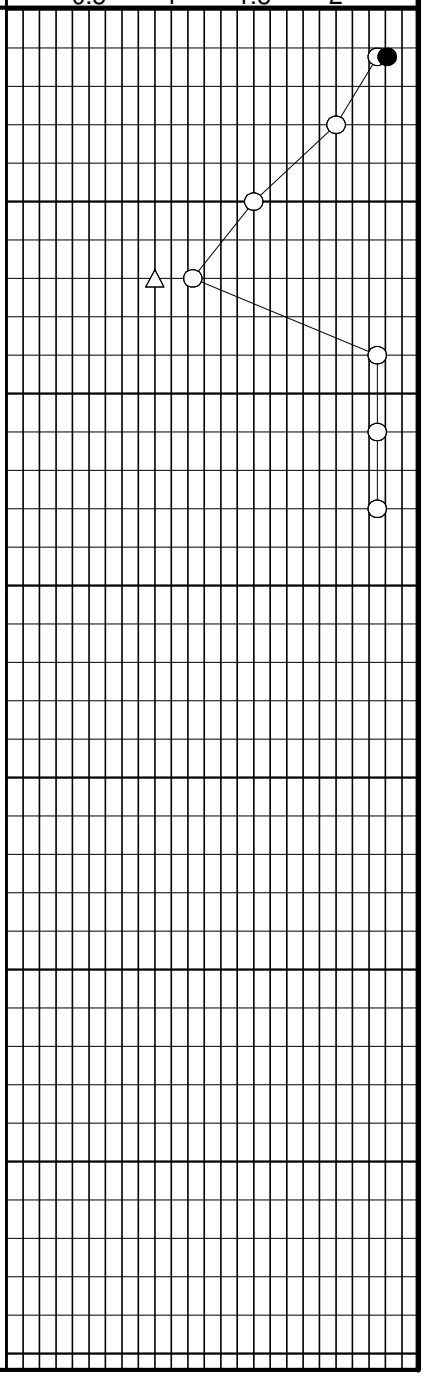
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
75				Stiff to hard, light gray and tan Lean Clay w/ Sand (CL), with silt partings and ferrous nodules			121	13			
				-with abundant calcareous nodules and siltstone fragments 0'-4'		71		14	32	16	16
	5			-with silt seams 2'-4'				16			
							112	19			
70				-with fat clay pockets 8'-10'							
								19			
	10			Hard, red, brown, and light gray Fat Clay (CH), with slickensides and silty clay seams		94		24	59	23	36
				-with ferrous nodules 10'-12'							
65				-with silt pockets, calcareous nodules, and siltstone fragments 12'-14'				17			
	15			Termination depth = 14 feet.							
60											
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3109504.05
Northing: 13902240.727
Elevation: 78.146

BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-43

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-42**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

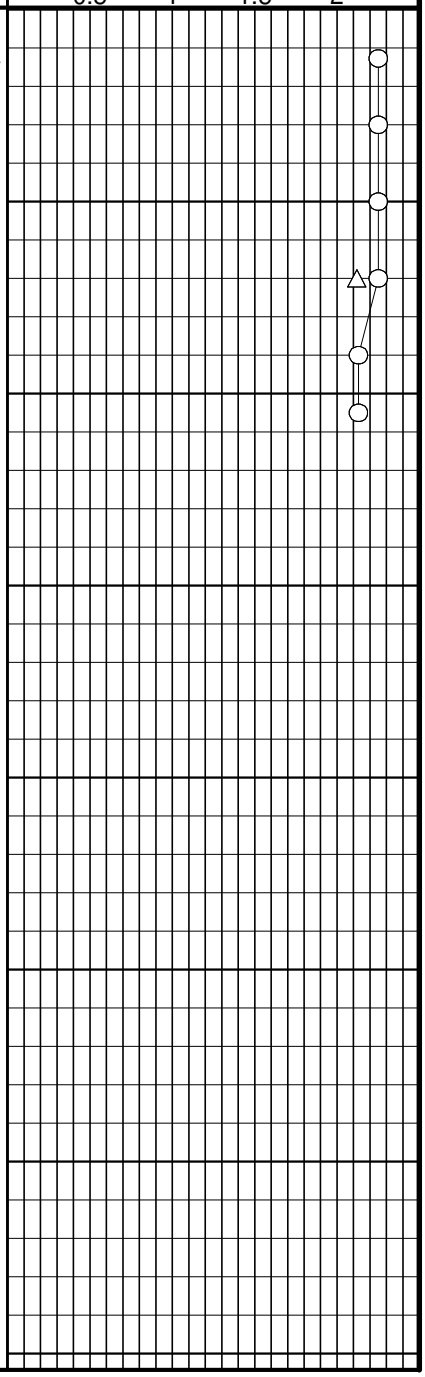
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.5" concrete							
		Hard, dark gray and light gray Lean Clay w/ Sand (CL), with silt partings, calcareous and ferrous nodules		77		13	30	16	14
75		-with abundant calcareous nodules 0'-2'				10			
	5					10			
		-light gray and tan 6'-10', with calcareous nodules 6'-8'			119	12			
70		-with silty clay pockets 8'-10'							
				83		15	48	17	31
	10	-red, brown, and light gray, with silt pockets 10'-12'				18			
		Termination depth = 11 feet.							
65	15								
60	20								
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **11** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-44**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-43**

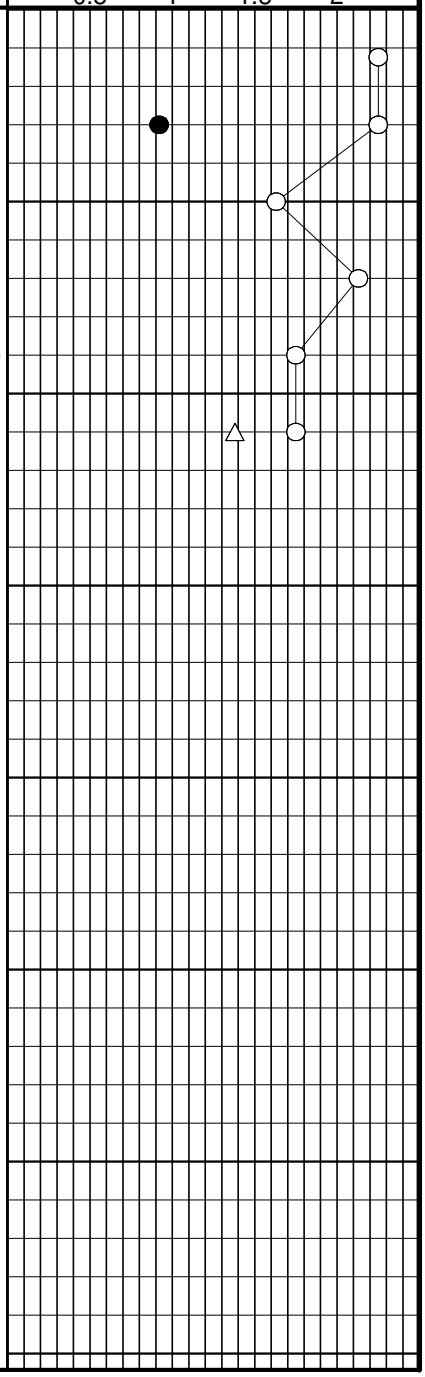
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3110306.89* *Northing: 13902494.922* *Elevation: 77.405*							
75	0			Pavement: 5.75" concrete							
				Stiff to hard, light gray and tan Sandy Lean Clay (CL), with silt partings, calcareous nodules, and siltstone fragments		68		14	27	19	8
				-with ferrous nodules 2'-8'			121	15			
	5							15			
70								16			
				Very stiff, tan and light gray Lean Clay w/ Sand (CL), with siltstone fragments		81		18	46	17	29
	10			-red, brown, and light gray, with silt pockets and calcareous nodules 10'-12'			111	19			
65				Termination depth = 12 feet.							
	15										
60											
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-45**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-44**

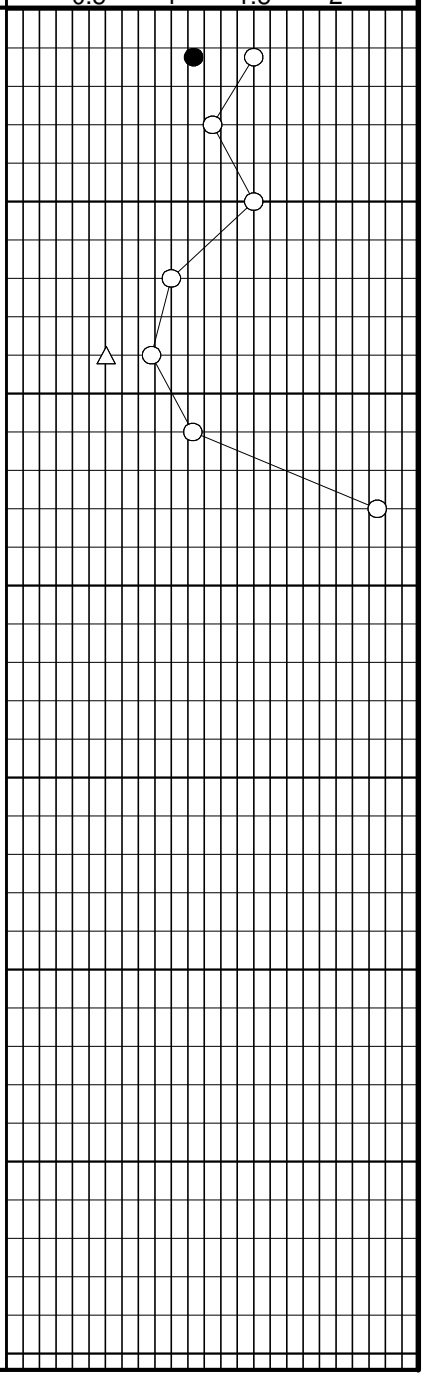
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/25/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.75" concrete							
75				Stiff to very stiff, dark gray Lean Clay (CL), with silt partings, siltstone fragments, and ferrous nodules -tan and light gray 2'-8'			116	16 14			
	5					76		16 18	32	16	16
70				Stiff to hard, tan and light gray Fat Clay (CH), with silt partings -with ferrous nodules 8'-10' -red, brown, and light gray 10'-14' -with silt pockets 12'-14'			110	20 18			
65	10					89		18	53	19	34
	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-46**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-45**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

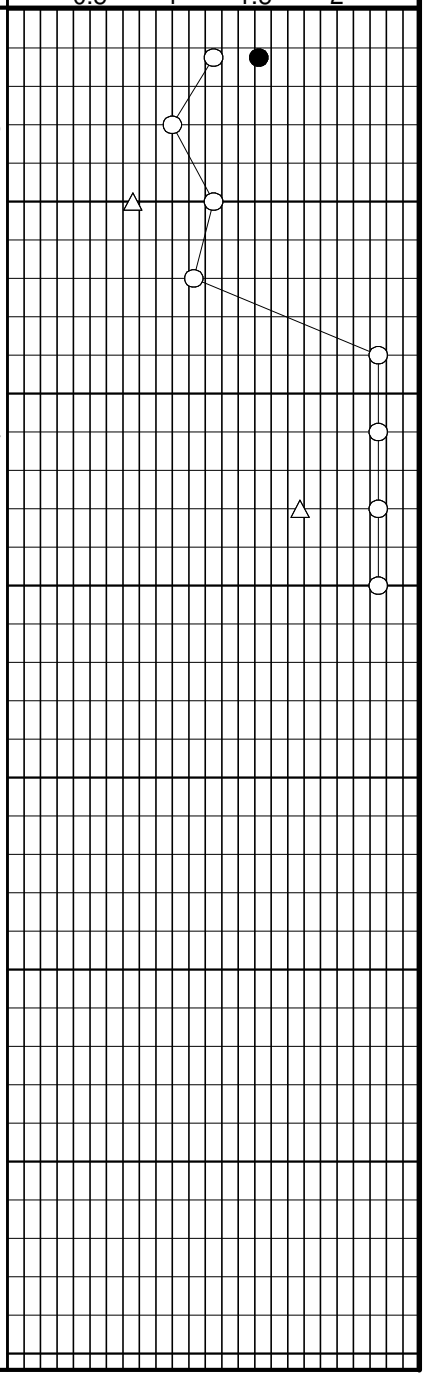
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6" concrete							
		Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with ferrous nodules, silt partings, and siltstone fragments			118	15			
		-light gray and tan 2'-8', with calcareous nodules 2'-4'		71		16	31	16	15
75	5				116	16			
		-with calcareous nodules 6'-8'				19			
		Very stiff to hard, tan and light gray Fat Clay (CH)				15			
70	10	-with silt partings and ferrous nodules 8'-12' and siltstone fragments 8'-10'		88		18	54	20	34
		-red, brown, and light gray, with abundant calcareous nodules and siltstone fragments 12'-14'			109	22			
65	15					18			
		Termination depth = 16 feet.							
60	20								
55	25								
50	30								
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **16** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-47**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-46**

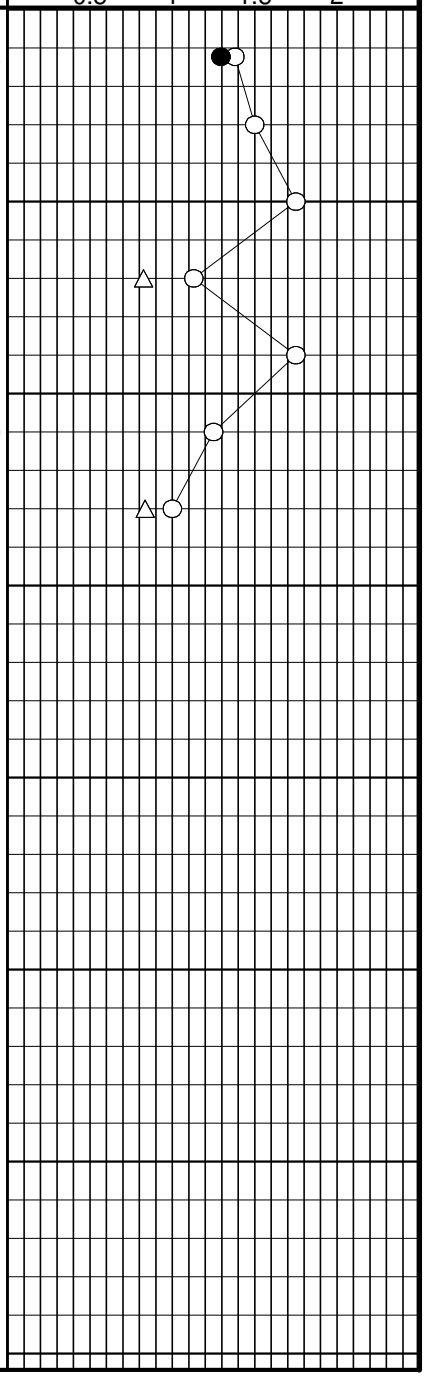
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3108315.893* *Northing: 13901412.023* *Elevation: 79.384*							
	0			Pavement: 5.5" concrete							
				Stiff to very stiff, dark gray Sandy Lean Clay (CL), with silt partings, siltstone fragments, and ferrous nodules		68	115	15	29	16	13
75				-tan 2'-6'				15			
	5			-tan and light gray 6'-8'				15			
							113	16			
				Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules				16			
70	10			-with fat clay pockets 10'-12'		85		18	44	15	29
				-with silt pockets and fat clay seams 12'-14'			105	22			
65	15			Termination depth = 14 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-48**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-47**

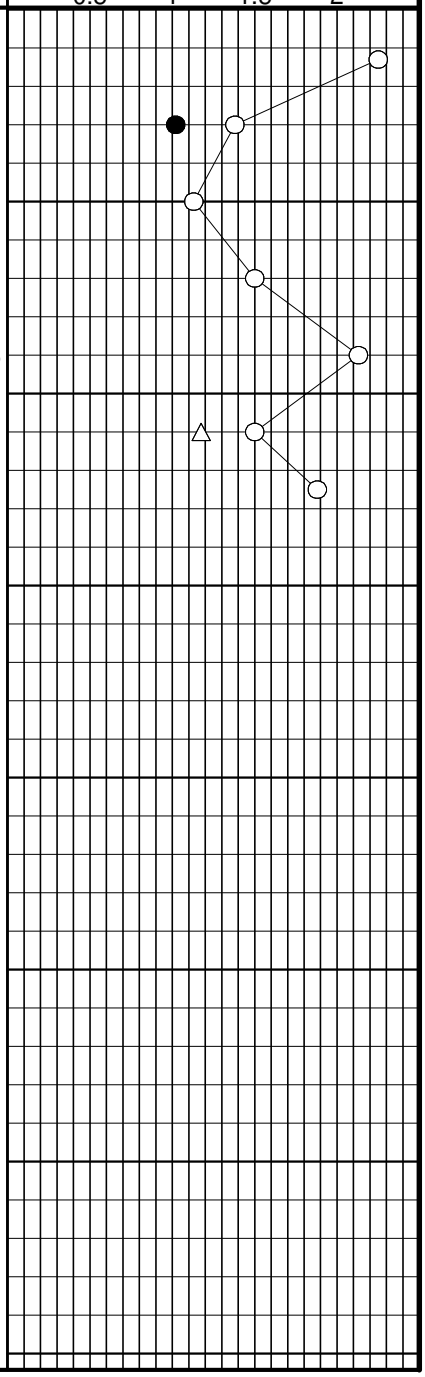
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 7.25" concrete							
				Very stiff to hard, dark gray Lean Clay w/ Sand (CL), with silt partings and ferrous nodules		77		12	26	17	9
				-tan and light gray 2'-12', with calcareous nodules and siltstone fragments 2'-10'			118	16			
75	5							16			
								15			
						84		16	41	15	26
70	10			-with vertical silty clayey sand partings 10'-12'			113	19			
								19			
				Termination depth = 13 feet.							
65	15										
60	20										
55	25										
50	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-49**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-48**

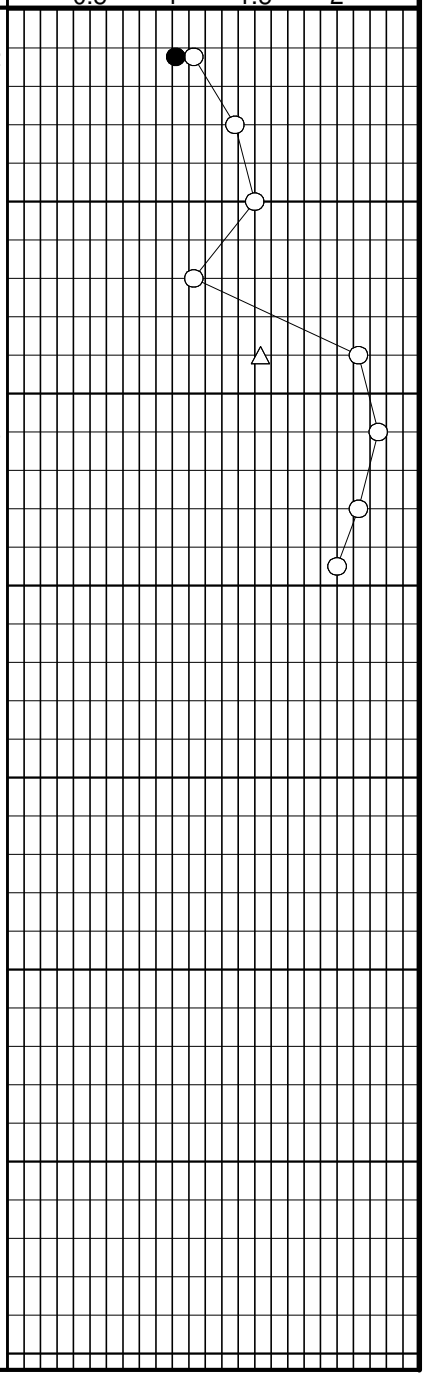
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5.5" concrete							
				Very stiff, dark gray Lean Clay w/Sand (CL), with silt partings, siltstone fragments, and ferrous nodules		77	111	18	38	16	22
75				-dark gray and tan 2'-4'				18			
	5			-red, tan, and light gray 4'-8'				16			
				-with fat clay pockets and silt seams 6'-8'				30			
70				Very stiff to hard, red, brown, light gray and tan Lean Clay (CL), with silt partings			114	18			
	10			-with fat clay pockets 8'-10'		89		18	40	17	23
				-with fat clay seams, siltstone fragments, and abundant calcareous nodules 12'-15'				20			
65	15							19			
				Termination depth = 15 feet.							
60	20										
55	25										
50	30										
45	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-50**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-49**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

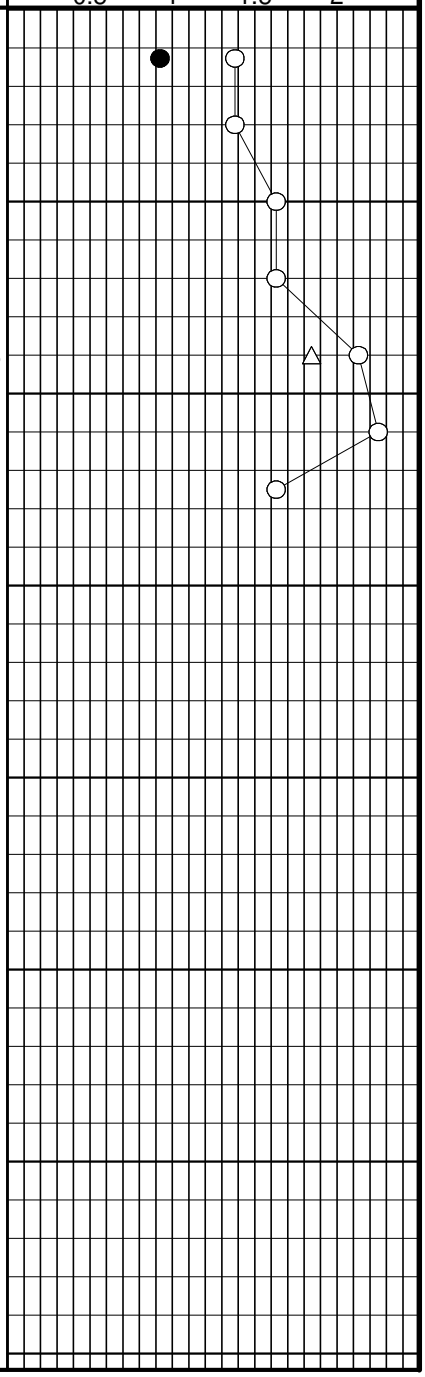
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
75				Stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules		70	117	16	36	15	21
				-with calcareous nodules and siltstone fragments 0'-6'				18			
	5			-tan and gray 2'-15'				22			
								16			
70				-with sand partings 8'-12'		78	118	16	44	16	28
	10			-with fat clay seams 10'-12'				17			
								15			
65				Termination depth = 13 feet.							
	15										
60											
	20										
55											
	25										
50											
	30										
45											
	35										

Survey Coordinates (TSPC, Surface):
Easting: 3109662.366
Northing: 13901975.854
Elevation: 78.393

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-51

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-50**

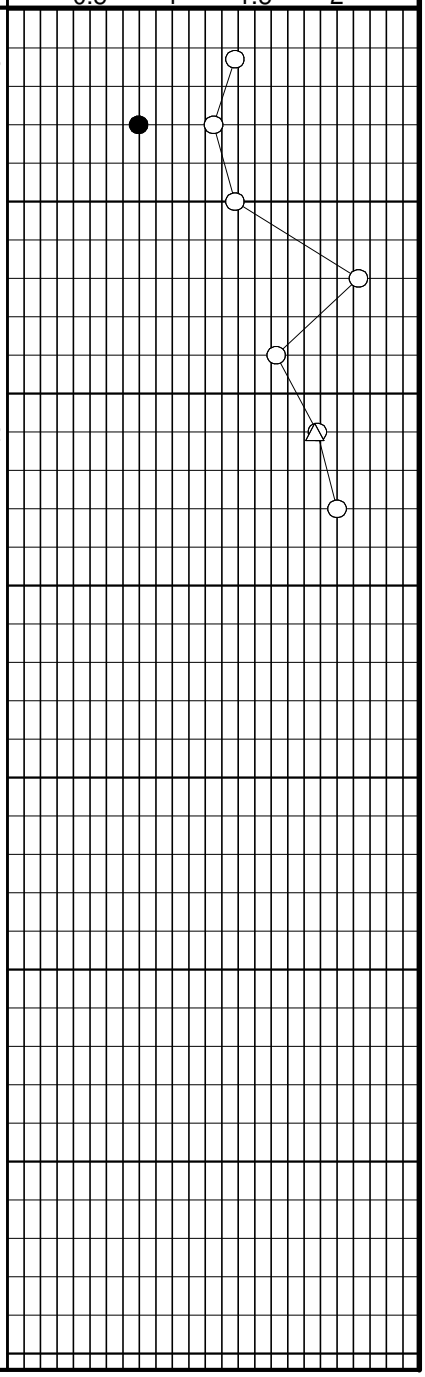
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3110192.131* *Northing: 13902046.578* *Elevation: 77.734*							
77	0			Pavement: 7" concrete							
				Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with silt partings and ferrous nodules		80		18	44	16	28
75				-with siltstone fragments 0'-6'			111	18			
	5							19			
								15			
70				Very stiff, light gray and tan Fat Clay (CH), with slickensides, silt partings and ferrous nodules				18			
	10			-red, tan, and light gray 10'-14'		90	112	21	51	19	32
65								21			
				Termination depth = 14 feet.							
	15										
60											
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-52

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-51**

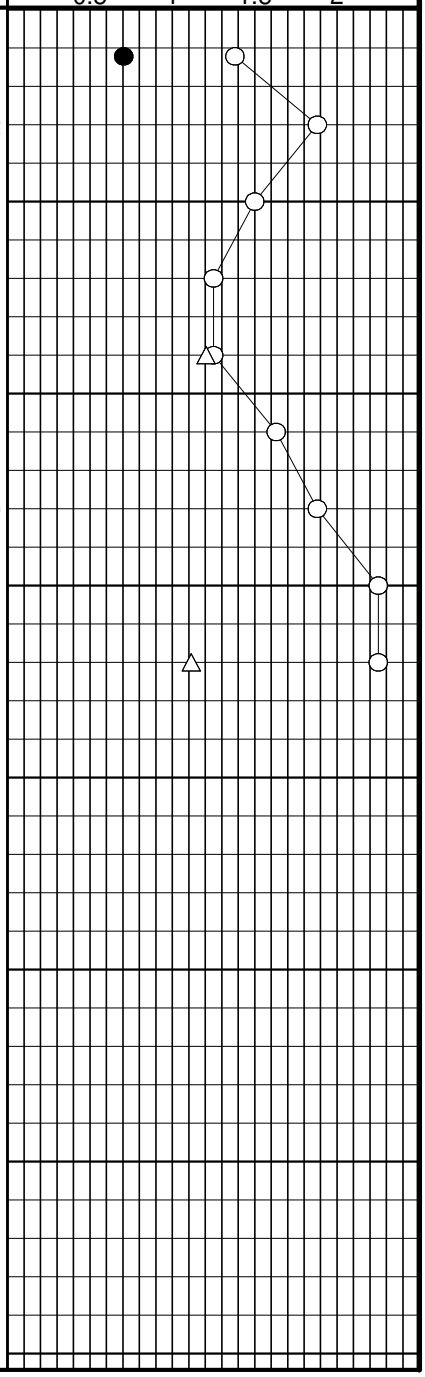
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5.25" concrete							
				Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with silt partings and ferrous nodules			119	15			
75				-with calcareous nodules and siltstone fragments 0'-8'		69		14	28	16	12
	5							14			
70								17			
				-with vertical silt seams 8'-10'			113	18			
	10			Very stiff to hard, red, brown, and light gray Lean Clay (CL), with slickensides and silty clay seams				23			
65				-with ferrous nodules 10'-12'		92		27	48	19	29
				-with calcareous nodules and siltstone fragments 12'-14'				25			
	15										
60				-with calcareous nodules and siltstone fragments 16'-18'			107	22			
				Termination depth = 18 feet.							
55	20										
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-53**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-52**

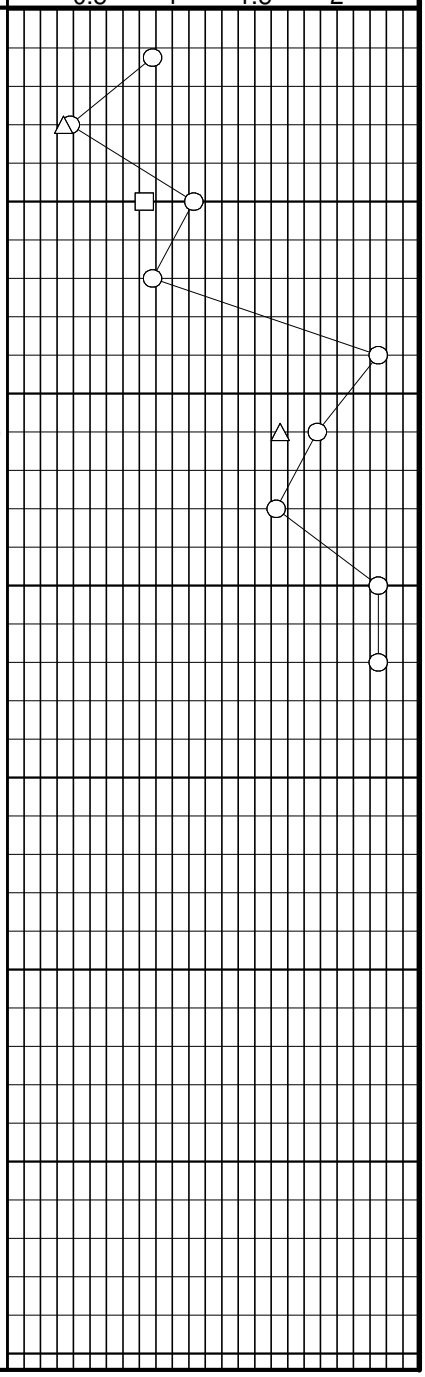
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3110930.642* *Northing: 13902705.71* *Elevation: 76.796*							
75	0			Pavement: 6" concrete				19			
				Firm to hard, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings -with calcareous nodules and siltstone fragments 2'-10'		75	105	21	26	17	9
70	5							17			
								19			
	10							15			
65				Very stiff to hard, red, brown, and light gray Lean Clay w/Sand (CL) -with vertical silt seams 10'-12' and ferrous nodules 10'-14' -with silty clay seams 12'-14' -with calcareous nodules and siltstone fragments 14'-18'		83	113	18	47	17	30
	15							18			
								24			
60								23			
				Termination depth = 18 feet.							
	20										
55											
	25										
50											
	30										
45											
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **8** FEET WHILE DRILLING ▽
WATER LEVEL AT **16.1** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-54**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-53**

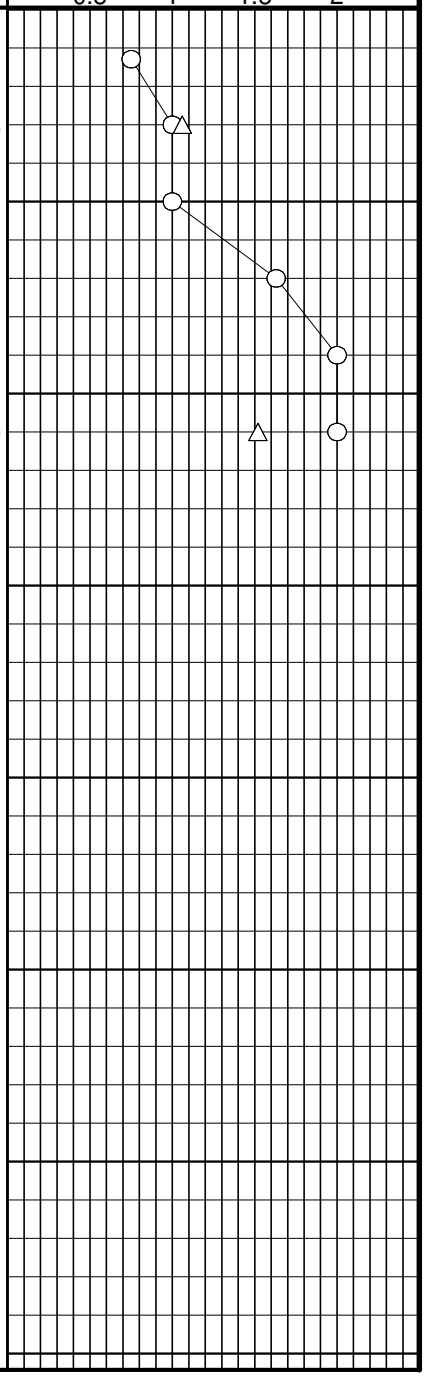
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger** DATE **11/19/14**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3111266.746* *Northing: 13902445.075* *Elevation: 76.411*							
75	0			Pavement: 7" concrete							
				Stiff to very stiff, gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules -tan and light gray 2'-12'				19			
						76	115	17	34	16	18
70	5							18			
								15			
				-with sand partings 8'-10'							
								16			
65	10			-with silt seams 10'-12'							
						82	112	19	44	15	29
				Termination depth = 12 feet.							
60	15										
55	20										
50	25										
45	30										
	35										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-55**

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-54**

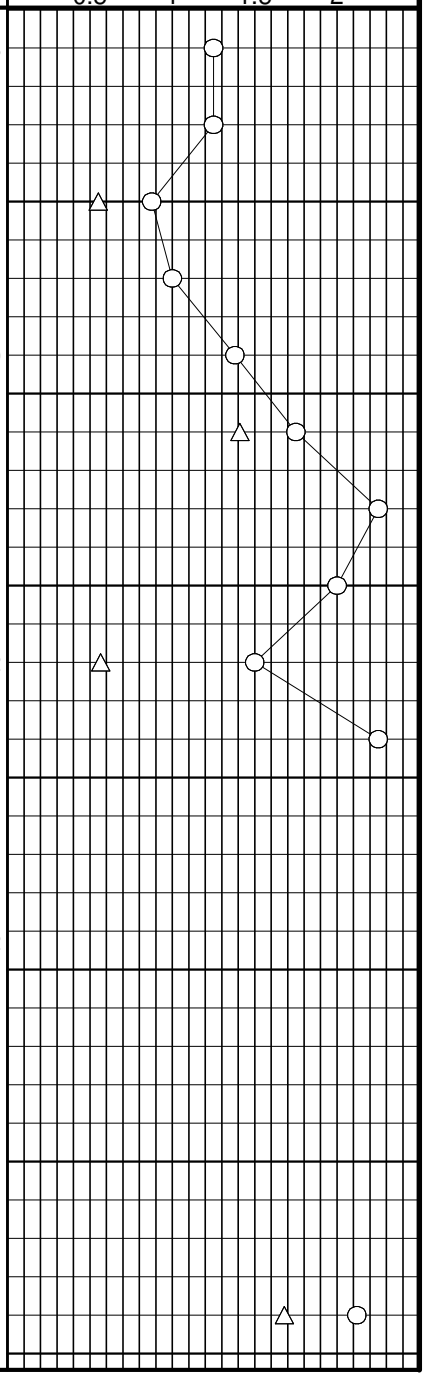
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger/Wet Rotary** DATE **11/10/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
		Stiff to very stiff, dark brown Sandy Lean Clay (CL), with abundant silt partings, siltstone fragments, calcareous and ferrous nodules		66		18	33	15	18
		-gray and red 2'-4'				17			
75	5	-gray and tan 4'-8'			111	19			
						21			
		Stiff to hard, light gray and tan Lean Clay w/ Sand (CL), with abundant silt partings and ferrous nodules		81		19	44	15	29
70	10				112	19			
						18			
		-red, brown, and light gray, with siltstone fragments and calcareous nodules 14'-18'				18			
65	15			74	105	19	40	18	22
		Hard, red, brown, and light gray Fat Clay (CH), with siltstone fragments and calcareous nodules				23			
60	20	Stiff to hard, red, brown, and light gray Lean Clay (CL), with abundant silt partings							
		-with fat clay seams 23'-25'	14	96		22	30	18	12
55	25								
		-red and brown, with abundant siltstone fragments 28'-30'	34			27			
50	30								
		Very stiff to hard, red, brown, and light gray Fat Clay (CH), with silt pockets and siltstone fragments			100	25			
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **25** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **23** FEET WHILE DRILLING ▽
WATER LEVEL AT **17.0** FEET AFTER **1/4 HR** ▽
DRILLED BY **SolTek** DRAFTED BY **WLW** LOGGED BY **BPJ/CHL**

PROJECT NO. G166-14 **PLATE A-56**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-54**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger/Wet Rotary** DATE **11/10/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
40	40	Hard, tan Silty Clay (CL-ML), with siltstone fragments	34	95		27	23	19	4
		Very stiff, red and brown Lean Clay (CL), with siltstone fragments				25			
35	45	Hard, tan and red Silty Clay (CL-ML), with abundant fat clay seams							
		-no recovery 48'-50'	50/ 5.5"						
30	50	Very stiff to hard, red and brown Fat Clay (CH), with slickensides and silt partings							
		-with siltstone fragments and silt pockets 53'-55'			96	27			
25	55								
		-with silty clay seams 58'-60'		87		27	71	23	48
20	60	Termination depth = 60 feet.							
15	65								
10	70								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **25** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **23** FEET WHILE DRILLING ▽
WATER LEVEL AT **17.0** FEET AFTER **1/4 HR** ▼
DRILLED BY **SolTek** DRAFTED BY **WLW** LOGGED BY **BPJ/CHL**

PROJECT NO. G166-14

PLATE A-56

PROJECT: **WL Replacement in Imperial Valley Area Package II** AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS BORING **B-55**

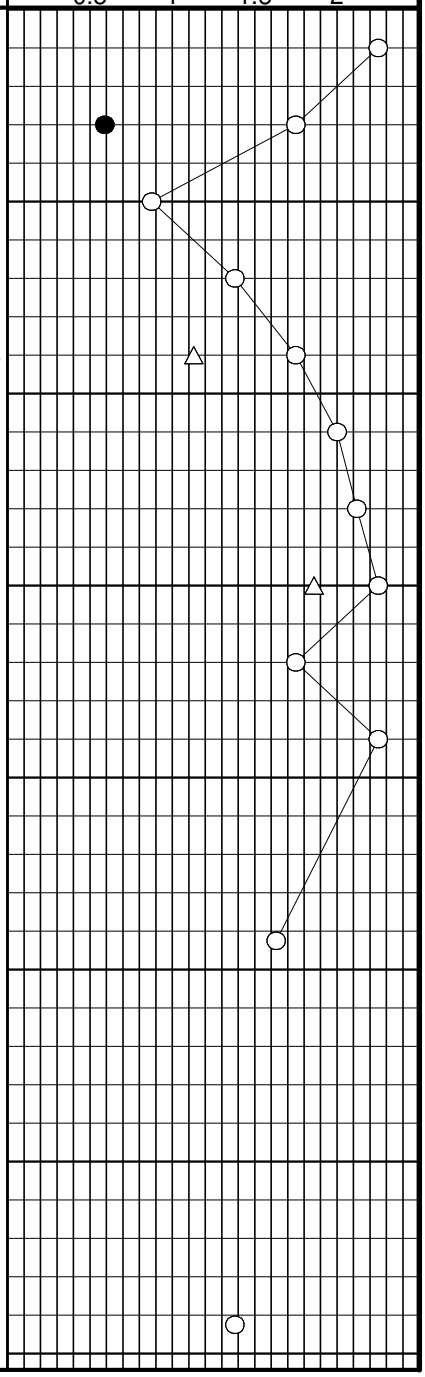
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger/Wet Rotary** DATE **11/7/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 6.25" concrete							
		Fill: hard, dark gray Silty Clay w/Sand (CL - ML), with silt layers and ferrous stains		72		14	25	18	7
		Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with abundant silt partings and ferrous nodules		61	117	16	29	16	13
75	5	-with siltstone fragments 2'-8'				16			
		-gray 4'-6'							
		Very stiff to hard, light gray and tan Lean Clay w/Sand (CL), with abundant silt partings				18			
		-with calcareous nodules 8'-10'		74	119	17	43	15	28
70	10	-with silt seams 10'-14'				19			
		-light gray, brown, and tan, with siltstone fragments 12'-14'				20			
65	15	-light gray, tan, and red, with calcareous nodules 14'-16'			115	18			
		Very stiff to hard, red, brown, and light gray Lean Clay (CL), with slickensides, silt partings, and calcareous nodules		93		32	40	19	21
		-with abundant silt seams 18'-20'				25			
60	20	Stiff to very stiff, red and brown Silty Clay (CL-ML)							
			16	92		17	28	21	7
55	25								
		Medium dense, red and brown Silt (ML), with clay partings							
			23	88		26	25	22	3
50	30								
		Firm to very stiff, red and brown Lean Clay (CL)							
			20			23			
45	35								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **25** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **25** FEET WHILE DRILLING ▽
WATER LEVEL AT **23.9** FEET AFTER **1/4 HR** ▽
DRILLED BY **SolTek** DRAFTED BY **WLW** LOGGED BY **BPJ**

PROJECT NO. G166-14 **PLATE A-57**

PROJECT: **WL Replacement in Imperial Valley Area Package II** BORING **B-55**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

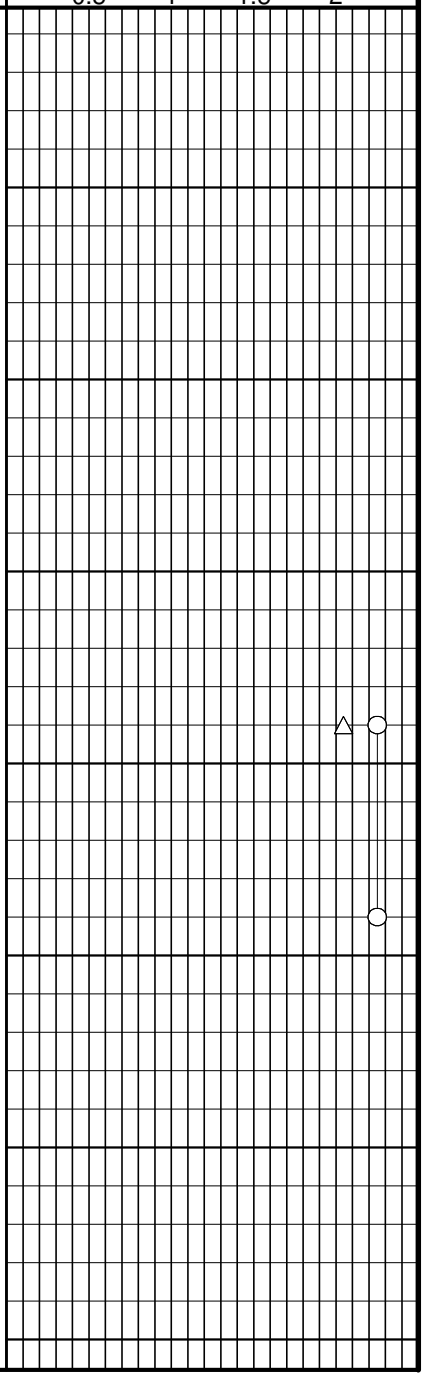
COH WBS No. **WBS No. S-000035-0197-4** TYPE **4" Dry Auger/Wet Rotary** DATE **11/7/14**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
40	40	Lean Clay (CL) (cont.)	6	94		25	28	15	13
		-no recovery 43'-45'	16						
35	45	Medium dense to dense, red and brown Silt w/Sand (ML)	28	74			np	np	np
30	50		47	76		25			
		Hard, red and brown Fat Clay (CH)			99	26			
25	55								
		Hard, tan Sandy Lean Clay (CL), with silt partings				19			
20	60	Termination depth = 60 feet.							
15	65								
10	70								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **25** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **25** FEET WHILE DRILLING ▽
WATER LEVEL AT **23.9** FEET AFTER **1/4 HR** ▽
DRILLED BY **SolTek** DRAFTED BY **WLW** LOGGED BY **BPJ**

PROJECT NO. G166-14

PLATE A-57

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Paving
	Low plasticity clay
	High plasticity clay
	Clayey sand
	Fill
	Description not given for: "FILL"
	Poorly graded clayey silty sand
	Silty low plasticity clay
	Silt
Misc. Symbols	
	Water table depth during drilling
	Pocket Penetrometer
	Unconfined Compression
	Confined Compression
	Subsequent water table depth
	Torvane

Symbol	Description
Soil Samplers	
	Rock core
	Undisturbed thin wall Shelby tube
	Auger
	Standard penetration test

AYLES ENGINEERING CORP.

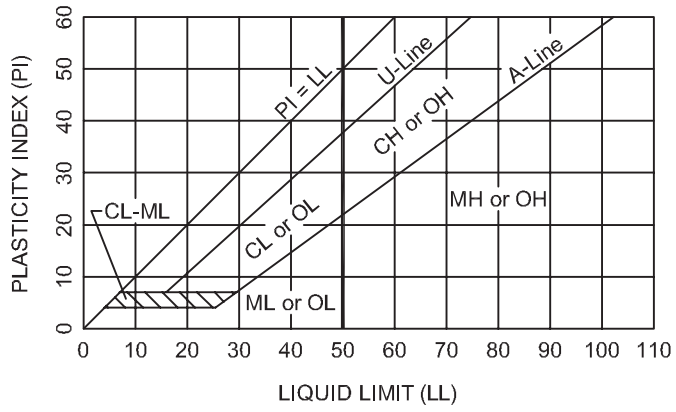
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation D-2487

MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (Less than 50% of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well-graded gravel, well-graded gravel with sand
				GP	Poorly-graded gravel, poorly-graded gravel with sand
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	GM	Silty gravel, silty gravel with sand
			Limits plot above "A" line & hatched zone on plasticity chart	GC	Clayey gravel, clayey gravel with sand
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)		SW	Well-graded sand, well-graded sand with gravel
				SP	Poorly-graded sand, poorly-graded sand with gravel
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	SM	Silty sand, silty sand with gravel
			Limits plot above "A" line & hatched zone on plasticity chart	SC	Clayey sand, clayey sand with gravel
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)		SILTS AND CLAYS (Liquid Limit Less Than 50%)		ML	Silt, silt with sand, silt with gravel, sandy silt, gravelly silt
				CL	Lean clay, lean clay with sand, lean clay with gravel, sandy lean clay, gravelly lean clay
				OL	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt
		SILTS AND CLAYS (Liquid Limit 50% or More)		MH	Elastic silt, elastic silt with sand, sandy elastic silt, gravelly elastic silt
				CH	Fat clay, fat clay with sand, fat clay with gravel, sandy fat clay, gravelly fat clay
				OH	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt

NOTE: Coarse soils between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone of the plasticity chart are to have dual symbols.

PLASTICITY CHART



Equation of A-Line: Horizontal at PI=4 to LL=25.5, then PI=0.73(LL-20)

Equation of U-Line: Vertical at LL=16 to PI=7, then PI=0.9(LL-8)

DEGREE OF PLASTICITY OF COHESIVE SOILS

Degree of Plasticity	Plasticity Index
None	0 - 4
Slight	5 - 10
Medium	11 - 20
High	21 - 40
Very High	>40

SOIL SYMBOLS

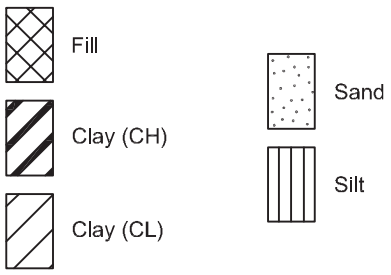


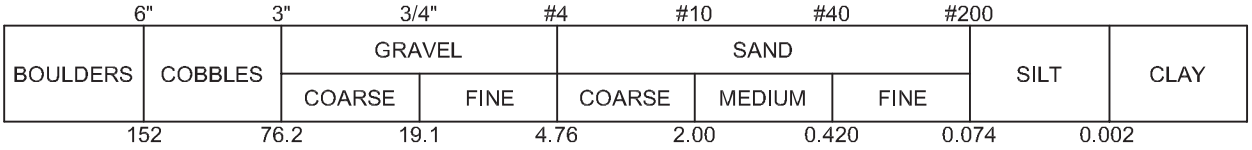
PLATE A-59

AYLES ENGINEERING CORP.

TERMS USED ON BORING LOGS

SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength, Kips per Sq. ft.
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

RELATIVE DENSITY OF COHESIONLESS SOILS FROM STANDARD PENETRATION TEST

Very Loose	<4 bpf
Loose	5-10 bpf
Medium Dense	11-30 bpf
Dense	31-50 bpf
Very Dense	>50 bpf

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows per Foot	Description
25	25 blows driving sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows driving sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows driving sampler 3 inches, during initial 6-inches seating interval.

NOTE: To avoid change to sampling tools, driving is limited to 50 blows during or after seating interval.

DRY STRENGTH ASTM D2488

None	Dry specimen crumbles into powder with mere pressure of handling
Low	Dry specimen crumbles into powder with some finger pressure
Medium	Dry specimen breaks into pieces or crumbles with considerable pressure
High	Dry specimen cannot be broken with finger pressure, it can be broken between thumb and hard surface
Very High	Dry specimen cannot be broken between thumb and hard surface

MOISTURE CONDITION ASTM D2488

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the easiness of breaking along these planes.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil types.
Interlayered	Soil sample composed of alternating layers of different soil types.
Intermixed	Soil sample composed of pockets of different soil types and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of calcium material.

AVILES
ENGINEERING CORP.

ASTM & TXDOT DESIGNATION FOR SOIL LABORATORY TESTS

NAME OF TEST	ASTM TEST DESIGNATION	TXDOT TEST DESIGNATION
Moisture Content	D 2216	Tex-103-E
Specific Gravity	D 854	Tex-108-E
Sieve Analysis	D 421 D 422	Tex-110-E (Part 1)
Hydrometer Analysis	D 422	Tex-110-E (Part 2)
Minus No. 200 Sieve	D 1140	Tex-111-E
Liquid Limit	D 4318	Tex-104-E
Plastic Limit	D 4318	Tex-105-E
Shrinkage Limit	D 427	Tex-107-E
Standard Proctor Compaction	D 698	Tex-114-E
Modified Proctor Compaction	D 1557	Tex-113-E
Permeability (constant head)	D 2434	-
Consolidation	D 2435	-
Direct Shear	D 3080	-
Unconfined Compression	D 2166	-
Unconsolidated-Undrained Triaxial	D 2850	Tex-118-E
Consolidated-Undrained Triaxial	D 4767	Tex-131-E
Pinhole Test	D 4647	-
California Bearing Ratio	D 1883	-
Unified Soil Classification System	D 2487	Tex-142-E

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-1	1	0.0	2.0	UD		17	113.6					1.49			2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		17		32	16	16	71.2				2.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		17									2.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18	114.2						3.73 (6)		3.25	Fat Clay (CH)
	6	10.0	12.0	UD		23		56	22	34	95.3				3.25	Fat Clay (CH)
	7	12.0	14.0	UD		21									3.00	Fat Clay (CH)
	8	14.0	16.0	UD		22									3.50	Fat Clay (CH)
B-2	1	0.0	2.0	UD		17	111.0	40	17	23	72.4	1.63			2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		19									1.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		17									2.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16	116.0	44	16	28	79.3		3.48 (6)		4.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		28									3.75	Lean Clay w/Sand (CL)
B-3	1	0.0	2.0	UD		11		33	16	17	68.3				4.50	Lean Clay (CL)
	2	2.0	4.0	UD		9									4.50	Lean Clay (CL)
	3	4.0	6.0	UD		11	119.5					5.10			4.50	Lean Clay (CL)
	4	6.0	8.0	UD		15									4.50	Lean Clay (CL)
	5	8.0	10.0	UD		20									4.50	Clayey Sand (SC)
	6	10.0	12.0	UD		16	112.5	47	19	28	48.1		2.20 (7)		4.25	Clayey Sand (SC)
	7	12.0	13.0	UD		29									2.25	Clayey Sand (SC)
B-4	1	0.0	2.0	UD		18									2.75	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		19	109.3	35	18	17	71.0	1.30			2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		19									2.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		23									1.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19									2.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		20	106.9						1.08 (7)		3.00	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		26		63	25	38	96.4				3.50	Fat Clay (CH)
	8	14.0	16.0	UD		23									4.00	Fat Clay (CH)
	9	16.0	18.0	UD		38									2.50	Fat Clay (CH)
	10	18.0	20.0	UD		35	89.2						0.70 (13)		2.50	Fat Clay (CH)
	11	23.0	25.0	UD		24		44	21	23	83.7				3.00	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-5	1	0.0	2.0	UD		13		32	15	17	72.1				4.50	Fill: Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		13	117.3					4.54			4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		11									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		14									4.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		20		40	15	25	75.9				2.00	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		29	92.6						0.93 (7)		1.25	Lean Clay w/Sand (CL)
	7	12.0	13.0	UD		28									2.00	Lean Clay w/Sand (CL)
B-6	1	0.0	2.0	UD		11	122.4	39	15	24	71.4	7.89			4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		10									4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		8									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		12									4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		22	108.4						4.50 (6)		4.50	Lean Clay (CL)
	6	10.0	12.0	UD		18		45	18	27	86.3				4.25	Lean Clay (CL)
	7	12.0	13.0	UD		17									4.25	Lean Clay (CL)
B-7	1	0.0	2.0	UD		11	121.3	34	15	19	75.7	1.59			4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		8									4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		11									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		14	119.0						5.38 (5)		4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		21		53	19	34	85.7				4.00	Fat Clay (CH)
	6	10.0	12.0	UD		25									3.75	Fat Clay (CH)
	7	12.0	13.0	UD		28	99.2						2.06 (8)		3.50	Fat Clay (CH)
B-8	1	0.0	2.0	UD		24	104.8	51	16	35	76.4	0.86			1.00	Fat Clay w/Sand (CH)
	2	2.0	4.0	UD		20									2.00	Fat Clay w/Sand (CH)
	3	4.0	6.0	UD		16									3.00	Fat Clay w/Sand (CH)
	4	6.0	8.0	UD		16									2.50	Fat Clay w/Sand (CH)
	5	8.0	10.0	UD		29									3.25	Lean Clay (CL)
	6	10.0	12.0	UD		21	106.1	48	18	30	88.5		3.20 (7)		4.25	Lean Clay (CL)
	7	12.0	14.0	UD		25									4.25	Fat Clay (CH)
	8	14.0	16.0	UD		27									4.50	Fat Clay (CH)
	9	16.0	18.0	UD		20									4.50	Fat Clay (CH)
	10	18.0	20.0	UD		24									4.50	Fat Clay (CH)
	11	20.0	21.0	UD		20	108.4	52	23	29	97.7		2.53 (14)		4.50	Fat Clay (CH)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-9	1	0.0	2.0	UD		17		33	16	17	73.0				1.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		10	124.7					1.76			3.25	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		15									3.75	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17									4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17									4.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		22	107.5	40	18	22	82.7		3.61 (7)		4.50	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		25									3.75	Lean Clay w/Sand (CL)
B-10	1	0.0	2.0	UD		18	116.7	34	16	18	54.4	1.85			1.75	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		16									2.00	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		16									2.75	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		16									3.75	Fat Clay (CH)
	5	8.0	10.0	UD		16	118.3						4.96 (6)		4.50	Fat Clay (CH)
	6	10.0	12.0	UD		21		54	19	35	94.0				4.25	Fat Clay (CH)
	7	12.0	14.0	UD		18									4.00	Fat Clay (CH)
B-11	1	0.0	2.0	UD		17		26	16	10	75.1				2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		21	106.2				74.4	0.69			0.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		20									1.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		15									4.50	Lean Clay (CL)
	6	10.0	12.0	UD		20	110.2	44	18	26	86.9		1.35 (7)		4.25	Lean Clay (CL)
	7	12.0	14.0	UD		19									4.50	Lean Clay (CL)
B-12	1	0.0	2.0	UD		17		33	16	17	74.1				3.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		17	116.4					1.62			2.25	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									2.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		20									4.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18									4.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		25	104.1						2.47 (7)		3.75	Fat Clay (CH)
	7	12.0	14.0	UD		28		67	27	40	98.5				3.50	Fat Clay (CH)
	8	14.0	15.0	UD		26									4.00	Fat Clay (CH)
B-13	1	0.0	2.0	UD		11		36	16	20	72.2				4.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		11	124.2					8.59			4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		11									4.50	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-13	4	6.0	8.0	UD		14									4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19									3.75	Fat Clay (CH)
	6	10.0	12.0	UD		22		50	18	32	85.7				4.50	Fat Clay (CH)
	7	12.0	14.0	UD		28	96.6						1.57 (9)		3.00	Fat Clay (CH)
	8	14.0	15.0	UD		27									2.50	Fat Clay (CH)
B-14	1	0.0	2.0	UD		18	115.0					1.84			2.25	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		19		46	17	29	73.5				1.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		15									3.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		15									4.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16	114.7						3.05 (6)		3.75	Lean Clay w/Sand (CL)
	6	10.0	11.0	UD		24		61	24	37	93.0				2.75	Fat Clay (CH)
B-15	1	0.0	2.0	UD		15	117.2					2.31			3.25	Fill: Lean Clay (CL)
	2	2.0	4.0	UD		15		30	17	13	72.7				4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									3.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		15									2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18	113.5						1.79 (6)		3.00	Lean Clay (CL)
	6	10.0	12.0	UD		18		47	17	30	89.1				3.50	Lean Clay (CL)
B-16	1	0.0	2.0	UD		15	117.9	31	17	14	74.7	4.38			3.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18									2.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		18									2.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									4.50	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		18	113.3						3.05 (6)		3.00	Sandy Lean Clay (CL)
	6	10.0	12.0	UD		16		32	18	14	67.9				4.50	Sandy Lean Clay (CL)
	7	12.0	14.0	UD		16									2.25	Sandy Lean Clay (CL)
	8	14.0	16.0	UD		18	113.0						0.98 (10)		2.00	Sandy Lean Clay (CL)
B-17	1	0.0	2.0	UD		13	120.5	28	16	12	74.0	3.05			3.75	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		15									2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									4.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		14									4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16	114.9	40	15	25	79.4		2.14 (6)		3.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		14									4.50	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-18	1	0.0	2.0	UD		12	117.0	29	18	14	54.4	1.49			2.75	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		17									2.25	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		17									2.25	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		18									2.50	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		19	108.8	29	15	14	80.4		0.90 (6)		1.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		22									2.00	Lean Clay w/Sand (CL)
B-19	1	0.0	2.0	UD		16										Base: stabilized clayey sand
	2	2.0	4.0	UD		11		31	24	7	20.5				2.25	Fill: Silty Clayey Sand (SC-SM)
	3	4.0	6.0	UD		22	101.2				74.2	0.31			0.75	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17									2.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		20									1.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		24	105.4	48	17	31	90.8		3.00 (7)		4.00	Lean Clay (CL)
	7	12.0	14.0	UD		19									4.50	Lean Clay (CL)
B-20	1	0.0	2.0	UD		22										Base: stabilized clay
	2	2.0	4.0	UD		19	112.9	34	16	18	77.7	1.25			1.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		18									1.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19									4.00	Fat Clay (CH)
	6	10.0	12.0	UD		21	105.3						2.51 (7)		4.00	Fat Clay (CH)
	7	12.0	14.0	UD		21		63	22	41	96.3				3.75	Fat Clay (CH)
	8	14.0	16.0	UD		24									4.25	Fat Clay (CH)
	9	16.0	18.0	UD		21									4.50	Fat Clay (CH)
B-21	1	0.0	2.0	UD		22		45	16	29	74.6				1.50	Fill: Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		19	110.7					2.28			2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		19									3.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17									2.75	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17		42	16	26	79.9				3.00	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	112.4						2.04 (7)		2.75	Lean Clay w/Sand (CL)
B-22	1	0.0	2.0	UD		15	119.4					2.77			3.25	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		12		39	14	25	79.4				4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		10									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		13									4.25	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-22	5	8.0	10.0	UD		15	117.7						3.62 (6)		4.50	Lean Clay (CL)
	6	10.0	12.0	UD		18									4.50	Lean Clay (CL)
	7	12.0	14.0	UD		25		45	19	26	89.9				3.25	Lean Clay (CL)
	8	14.0	15.0	UD		16	110.4						0.98 (10)		1.00	Lean Clay (CL)
B-23	1	0.0	2.0	UD		13	121.9					5.14			4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		12		34	15	19	76.4				4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		14									3.75	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16	118.0						4.51 (5)		4.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17									3.75	Lean Clay (CL)
	6	10.0	12.0	UD		19		46	16	30	86.3				4.25	Lean Clay (CL)
	7	12.0	14.0	UD		19									4.50	Lean Clay (CL)
B-24	1	0.0	2.0	UD		14		27	15	12	76.4				4.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		14	118.8					2.18			4.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									3.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.75	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19	113.8	35	16	21	79.0		1.16 (6)		2.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19									3.00	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		19									2.50	Silty Clayey Sand (SC-SM)
	8	14.0	16.0	UD		17	111.8	28	22	6	37.6		0.82 (10)		2.25	Silty Clayey Sand (SC-SM)
B-25	1	0.0	2.0	UD		16									4.50	Fat Clay (CH)
	2	2.0	4.0	UD		20	107.5	53	17	36	89.5	5.98			4.25	Fat Clay (CH)
	3	4.0	6.0	UD		22									4.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		18									3.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18									3.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		20	106.8	39	18	21	84.6		1.98 (7)		2.75	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		19									4.50	Lean Clay w/Sand (CL)
B-26	1	0.0	2.0	UD		14		27	18	9	66.4				3.25	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		13	117.9					2.15			3.25	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		16									2.25	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		16									2.25	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		17		45	16	29	77.9		1.75 (7)		3.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		17	112.7								2.25	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-27	1	0.0	2.0	UD		15	119.4					4.01			4.50	Fill: Lean Clay (CL)
	2	2.0	4.0	UD		9		26	15	11	66.4				4.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		12									4.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		13									4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16	116.2	43	15	28	78.4		3.48 (6)		4.00	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		16									4.50	Lean Clay w/Sand (CL)
B-28	1	0.0	2.0	UD		14	119.9					4.92			3.25	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		12		30	15	15	74.4				4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		10									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16	113.9						3.43 (5)		2.75	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16		44	17	27	80.3				3.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		20									4.50	Lean Clay w/Sand (CL)
B-29	1	0.0	2.0	UD		12									4.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		12		27	15	12	68.0				4.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		14	117.7					3.90			3.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		18									2.75	Lean Clay (CL)
	5	8.0	10.0	UD		15									4.50	Lean Clay (CL)
	6	10.0	12.0	UD		16	113.9	49	19	30	91.2		4.74 (7)		3.75	Lean Clay (CL)
	7	12.0	14.0	UD		19									4.25	Lean Clay (CL)
B-30	1	0.0	2.0	UD		15									3.50	Clayey Sand (SC)
	2	2.0	4.0	UD		12		33	16	17	44.0				4.00	Clayey Sand (SC)
	3	4.0	6.0	UD		18	111.5					1.41			2.25	Lean Clay (CL)
	4	6.0	8.0	UD		17									3.75	Lean Clay (CL)
	5	8.0	10.0	UD		19	110.8	44	15	29	88.6		2.72 (6)		3.25	Lean Clay (CL)
	6	10.0	12.0	UD		12									4.50	Lean Clay (CL)
B-31	1	0.0	2.0	UD		12	121.1					1.91			2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		17		28	16	12	78.3				2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									1.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17	112.8					1.67			3.50	Lean Clay (CL)
	5	8.0	10.0	UD		14		40	15	25	85.7				4.00	Lean Clay (CL)
	6	10.0	11.0	UD		15									4.50	Lean Clay (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-32	1	0.0	2.0	UD		14									1.75	Silty Clay w/Sand (CL-ML)
	2	2.0	4.0	UD		17	108.5	24	17	7	75.0	0.77			1.25	Silty Clay w/Sand (CL-ML)
	3	4.0	6.0	UD		17									2.75	Silty Clay w/Sand (CL-ML)
	4	6.0	8.0	UD		16									3.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17		27	17	10	72.8				2.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		23	102.4						0.68 (7)		1.50	Lean Clay w/Sand (CL)
B-33	1	0.0	2.0	UD		18	114.2					2.30			2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		19		47	17	30	70.1				2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									4.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19	112.6						3.23 (6)		4.50	Fat Clay (CH)
	6	10.0	12.0	UD		24									3.75	Fat Clay (CH)
	7	12.0	14.0	UD		20		61	22	39	94.9				3.75	Fat Clay (CH)
	8	14.0	16.0	UD		21									4.50	Fat Clay (CH)
B-34	1	0.0	2.0	UD		9	123.3	33	16	17	62.2	5.75			4.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		9									4.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		10									4.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		17	111.8						1.61 (5)		2.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18		47	16	31	73.3				3.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		17									4.00	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		22									3.50	Lean Clay w/Sand (CL)
B-35	1	0.0	2.0	UD		9	125.7	29	18	11	59.6	7.31			4.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		8									4.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		12									4.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		15									2.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18	111.5	41	14	27	74.1		1.51 (6)		2.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		17									3.25	Lean Clay w/Sand (CL)
B-36	1	0.0	2.0	UD		15	117.2					1.99			2.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18		43	15	28	83.3				3.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		18									2.75	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		18									3.75	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17	115.2	43	15	28	85.3		3.96 (6)		4.00	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-36	6	10.0	11.0	UD		19									4.50	Lean Clay w/Sand (CL)
B-37	1	0.0	2.0	UD		14	120.3	29	17	12	64.0	2.63			2.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		15									2.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		15									3.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		16									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18	114.0						3.85 (6)		3.00	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		24		46	16	30	78.9				3.25	Lean Clay w/Sand (CL)
B-38	1	0.0	2.0	UD		14	121.4					3.42			4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		17		25	17	8	78.9				1.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		18									2.00	Sandy Silty Clay (CL-ML)
	4	6.0	8.0	UD		21		22	18	4	67.8			0.42	0.00	Sandy Silty Clay (CL-ML)
	5	8.0	10.0	UD		20									1.75	Sandy Silty Clay (CL-ML)
	6	10.0	12.0	UD		18									3.50	Fat Clay (CH)
	7	12.0	14.0	UD		26		51	19	32	86.7				3.75	Fat Clay (CH)
B-39	1	0.0	2.0	UD		15		26	18	8	73.0				3.25	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		14	117.2					1.99			2.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									2.75	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17									2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17									4.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	111.5	58	21	37	90.2		2.51 (7)		4.50	Fat Clay (CH)
	7	12.0	14.0	UD		16									3.25	Fat Clay (CH)
	8	14.0	16.0	UD		19									4.00	Fat Clay (CH)
B-40	1	0.0	2.0	UD		15									3.00	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18	112.6	30	16	14	77.1	2.08			1.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		15									3.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		17									2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18									3.75	Fat Clay (CH)
	6	10.0	12.0	UD		22	107.1	53	20	33	90.7		3.82 (7)		4.00	Fat Clay (CH)
	7	12.0	14.0	UD		21									4.00	Fat Clay (CH)
B-41	1	0.0	2.0	UD		13	121.4					4.62			4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		14		32	16	16	71.1				4.00	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-41	3	4.0	6.0	UD		16									3.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		19	112.1						1.80 (5)		2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		19									4.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		24		59	23	36	94.0				4.50	Fat Clay (CH)
	7	12.0	14.0	UD		17									4.50	Fat Clay (CH)
B-42	1	0.0	2.0	UD		13		30	16	14	76.5				4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		10									4.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		10									4.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		12	118.9						4.24 (5)		4.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		15		48	17	31	83.3				4.25	Lean Clay w/Sand (CL)
	6	10.0	11.0	UD		18									4.25	Lean Clay w/Sand (CL)
B-43	1	0.0	2.0	UD		14		27	19	8	67.6				4.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		15	121.3					1.84			4.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		15									3.25	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		16									4.25	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		18		46	17	29	80.7				3.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	111.2						2.75 (7)		3.50	Lean Clay w/Sand (CL)
B-44	1	0.0	2.0	UD		16	115.7					2.27			3.00	Lean Clay (CL)
	2	2.0	4.0	UD		14									2.50	Lean Clay (CL)
	3	4.0	6.0	UD		16		32	16	16	76.1				3.00	Lean Clay (CL)
	4	6.0	8.0	UD		18									2.00	Lean Clay (CL)
	5	8.0	10.0	UD		20	110.4						1.21 (6)		1.75	Fat Clay (CH)
	6	10.0	12.0	UD		18									2.25	Fat Clay (CH)
	7	12.0	14.0	UD		18		53	19	34	89.1				4.50	Fat Clay (CH)
B-45	1	0.0	2.0	UD		15	117.5					3.05			2.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		16		31	16	15	71.2				2.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16	115.9						1.52 (3)		2.50	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		19									2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		15									4.50	Fat Clay (CH)
	6	10.0	12.0	UD		18		54	20	34	87.9				4.50	Fat Clay (CH)
	7	12.0	14.0	UD		22	109.2						3.55 (9)		4.50	Fat Clay (CH)
	8	14.0	16.0	UD		18									4.50	Fat Clay (CH)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-46	1	0.0	2.0	UD		15	115.3	29	16	13	68.0	2.59			2.75	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		15									3.00	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		15									3.50	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		16	113.4						1.65 (5)		2.25	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		16									3.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		18		44	15	29	84.5				2.50	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		22	105.2						1.67 (9)		2.00	Lean Clay w/Sand (CL)
B-47	1	0.0	2.0	UD		12		26	17	9	76.7				4.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		16	118.0					2.04			2.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									2.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		15									3.00	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16		41	15	26	84.3				4.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	112.9						2.35 (7)		3.00	Lean Clay w/Sand (CL)
	7	12.0	13.0	UD		19									3.75	Lean Clay w/Sand (CL)
B-48	1	0.0	2.0	UD		18	111.0	38	16	22	76.5	2.04			2.25	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18									2.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		16									3.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		30									2.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18	114.1						3.07 (6)		4.25	Lean Clay (CL)
	6	10.0	12.0	UD		18		40	17	23	88.7				4.50	Lean Clay (CL)
	7	12.0	14.0	UD		20									4.25	Lean Clay (CL)
	8	14.0	15.0	UD		19									4.00	Lean Clay (CL)
B-49	1	0.0	2.0	UD		16	117.4	36	15	21	70.4	1.95			2.75	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18									2.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		22									3.25	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		16									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16	117.6	44	16	28	77.7		3.69 (6)		4.25	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		17									4.50	Lean Clay w/Sand (CL)
	7	12.0	13.0	UD		15									3.25	Lean Clay w/Sand (CL)
B-50	1	0.0	2.0	UD		18		44	16	28	79.5				2.75	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		18	110.5					1.59			2.50	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		19									2.75	Lean Clay w/Sand (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS	Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II
	WBS Number: S-000135-0197-3
Aviles Engineering Corporation	AEC Project Number: G166-14

Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-50	4	6.0	8.0	UD		15									4.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		18									3.25	Fat Clay (CH)
	6	10.0	12.0	UD		21	112.0	51	19	32	89.7		3.73 (7)		3.75	Fat Clay (CH)
	7	12.0	14.0	UD		21									4.00	Fat Clay (CH)
B-51	1	0.0	2.0	UD		15	118.5					1.41			2.75	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		14		28	16	12	68.6				3.75	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		14									3.00	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		17									2.50	Sandy Lean Clay (CL)
	5	8.0	10.0	UD		18	113.3						2.41 (6)		2.50	Sandy Lean Clay (CL)
	6	10.0	12.0	UD		23									3.25	Lean Clay (CL)
	7	12.0	14.0	UD		27		48	19	29	91.6				3.75	Lean Clay (CL)
	8	14.0	16.0	UD		25									4.50	Lean Clay (CL)
	9	16.0	18.0	UD		22	106.6						2.23 (11)		4.50	Lean Clay (CL)
B-52	1	0.0	2.0	UD		19									2.75	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		21	105.0	26	17	9	75.2	0.68			3.75	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		17								0.83	3.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		19									2.50	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		15									2.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		18	113.3	47	17	30	83.4		3.31 (7)		3.25	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		18									3.75	Lean Clay w/Sand (CL)
	8	14.0	16.0	UD		24									4.50	Lean Clay w/Sand (CL)
	9	16.0	18.0	UD		23									4.50	Lean Clay w/Sand (CL)
B-53	1	0.0	2.0	UD		19									1.50	Lean Clay w/Sand (CL)
	2	2.0	4.0	UD		17	115.3	34	16	18	76.3	2.12			2.00	Lean Clay w/Sand (CL)
	3	4.0	6.0	UD		18									2.00	Lean Clay w/Sand (CL)
	4	6.0	8.0	UD		15									3.25	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		16									4.00	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	111.9	44	15	29	82.2		3.04 (7)		4.00	Lean Clay w/Sand (CL)
B-54	1	0.0	2.0	UD		18		33	15	18	66.2				2.50	Sandy Lean Clay (CL)
	2	2.0	4.0	UD		17									2.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		19	110.8						1.10 (3)		1.75	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		21									2.00	Sandy Lean Clay (CL)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

SUMMARY OF TEST RESULTS					Project Name: WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA PACKAGE II											
					WBS Number: S-000135-0197-3											
Aviles Engineering Corporation					AEC Project Number: G166-14											
Boring No.	Sample				SPT (blows/ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-54	5	8.0	10.0	UD		19		44	15	29	81.2				2.75	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19	112.0						2.82 (7)		3.50	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		18									4.50	Lean Clay w/Sand (CL)
	8	14.0	16.0	UD		18									4.00	Lean Clay w/Sand (CL)
	9	16.0	18.0	UD		19	105.2	40	18	22	74.4		1.13 (11)		3.00	Lean Clay w/Sand (CL)
	10	18.0	20.0	UD		23									4.50	Fat Clay (CH)
	11	23.0	25.0	SPT	14	22					96.1					Lean Clay (CL)
	12	28.0	30.0	SPT	34	27										Lean Clay (CL)
	13	33.0	35.0	UD		25	99.9						3.36 (17)		4.25	Fat Clay (CH)
	14	38.0	40.0	SPT	34	27		23	19	4	95.3					Silty Clay (CL-ML)
	15	43.0	45.0	UD		25									2.50	Lean Clay (CL)
	16	48.0	50.0	SPT	50/5.5"											Silty Clay (CL-ML)
	17	53.0	55.0	UD		27	95.6						2.94 (24)		4.50	Fat Clay (CH)
	18	58.0	60.0	UD		27		71	23	48	87.4				4.50	Fat Clay (CH)
B-55	1	0.0	2.0	UD		14		25	18	7	71.6				4.50	Fill: Silty Clay w/Sand (CL-ML)
	2	2.0	4.0	UD		16	117.3					1.18			3.50	Sandy Lean Clay (CL)
	3	4.0	6.0	UD		16									1.75	Sandy Lean Clay (CL)
	4	6.0	8.0	UD		18									2.75	Lean Clay w/Sand (CL)
	5	8.0	10.0	UD		17	118.5	43	15	28	74.0		2.26 (6)		3.50	Lean Clay w/Sand (CL)
	6	10.0	12.0	UD		19									4.00	Lean Clay w/Sand (CL)
	7	12.0	14.0	UD		20									4.25	Lean Clay w/Sand (CL)
	8	14.0	16.0	UD		18	114.8								4.50	Lean Clay w/Sand (CL)
	9	16.0	18.0	UD		32		40	19	21	93.4		3.72 (10)		3.50	Lean Clay (CL)
	10	18.0	20.0	UD		25									4.50	Lean Clay (CL)
	11	23.0	25.0	SPT	16	17		28	21	7	92.1					Silty Clay (CL-ML)
	12	28.0	30.0	SPT	23	26					88.4					Silt (ML)
	13	33.0	35.0	SPT	20	23									2.75	Lean Clay (CL)
	14	38.0	40.0	SPT	6	25										Lean Clay (CL)
	15	43.0	45.0	SPT	16											
	16	48.0	50.0	SPT	28			np	np	np	74.1					Silt w/Sand (ML)
	17	50.0	52.0	SPT	47	25					76.3					Silt w/Sand (ML)
	18	53.0	55.0	UD		26	99.2						4.09 (26)		4.50	Fat Clay (CH)
	19	58.0	60.0	UD		19									4.50	Fat Clay (CH)

Legend			Notes:
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	SPT = Standard Penetration Test	UU = Triaxial Compession	

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ENGINEERING CORP.

APPENDIX B

Plates B-1a to B-7	Generalized Soil Profiles
Plates B-8 and B-9	Piezometer Installation Details

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG AIRLINE

SOUTH

NORTH

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-38

Pvmt: 6.25" concrete

Stiff to hard, light gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules

Very soft to very stiff, light gray Sandy Silty Clay (CL-ML), with ferrous nodules
-with siltstone fragments 6'-10'

Very stiff, red, brown, and light gray Fat Clay (CH), with slickensides, silt pockets, and ferrous nodules
-with silt seams 12'-14'

Termination depth = 14 feet.

B-32

Pavement: 8" concrete

Firm to very stiff, dark gray Silty Clay w/Sand (CL-ML), with silt seams
-with vertical silt seams 2'-4'

-tan and gray 4'-6'

Firm to very stiff, light gray and tan Lean Clay w/Sand (CL), with silt partings
-with ferrous nodules 6'-8'
-with siltstone fragments 8'-10'

Termination depth = 12 feet.

B-19

Pavement: 9" concrete

Base: 15" lime-stabilized clayey sand

Fill: dark gray Silty Clayey Sand (SC-SM), with shell and ferrous nodules

Soft to very stiff, dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules
-with calcareous nodules and siltstone fragments 4'-8'
-tan and light gray 6'-10'

Very stiff to hard, tan and light gray Lean Clay (CL), with fat clay pockets, silt partings, and ferrous nodules
-red, brown, and light gray 12'-14'

Termination depth = 14 feet.

B-11

Pavement: 9" concrete

Firm to very stiff, dark gray Lean Clay w/Sand (CL), with silt partings

-light gray and tan 4'-8', with calcareous nodules and siltstone fragments 4'-6'

Stiff to hard, light gray and tan Lean Clay (CL), with ferrous nodules and silt partings

-with fat clay seams 12'-14'

Termination depth = 14 feet.

LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Depth of water first encountered during drilling
- Clayey sand
- Silty sand
- Depth of water ~15 min. after initial encounter
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Depth of water in piezometer 11/17/15
- Silty low plasticity clay
- Silt

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G166-14	1-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-1a

GENERALIZED SUBSURFACE SOIL PROFILE

CONTINUED ALONG AIRLINE

SOUTH

NORTH

BASELINE STATIONS

20+00 22+00 24+00 26+00 28+00 30+00 32+00 34+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-4 (PZ-1)

Pavement: 7" concrete

Stiff to very stiff, dark gray Lean Clay w/Sand (CL), with silt partings
-with siltstone fragments 0'-8', and ferrous nodules 0'-2'
-light gray 2'-4'

-with calcareous nodules 4'-10'

-tan and gray 8'-12'

-with fat clay pockets and seams 10'-12'

Firm to very stiff, red, brown, and light gray Fat Clay (CH), with slickensides

-with vertical silt partings 14'-16'

-with silty clay seams 16'-20'

-with siltstone fragments and calcareous and ferrous nodules 18'-20'

Very stiff, red, brown, and light gray Lean Clay w/Sand (CL), with silty clay seams, calcareous nodules, and siltstone fragments
-boring caved at 23' after drilling

Termination depth = 25 feet.

B-2

Pavement: 8.75" concrete

Stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules
-with siltstone fragments 0'-8'
-light gray and tan 2'-10', with calcareous nodules 2'-6'

-with fat clay pockets 8'-12'

-red, brown, and light gray, with silty clay seams 10'-12'

Termination depth = 12 feet.

B-1

Pavement: 8.25" concrete

Stiff to very stiff, dark gray Lean Clay w/Sand (CL), with silt partings
-light gray and tan, with ferrous nodules and siltstone fragments 2'-8'

-with calcareous nodules 4'-8'

-with fat clay pockets 6'-8'

Very stiff, tan and light gray Fat Clay (CH), with ferrous nodules
-with silt pockets 8'-12'

-red, brown, and light gray 12'-16', wet at 12'

Termination depth = 16 feet.

LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Clayey sand
- Silty sand
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Silty low plasticity clay
- Silt
- Depth of water first encountered during drilling
- Depth of water ~15 min. after initial encounter
- Depth of water in piezometer 11/17/15

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

AEC PROJECT NO.: G166-14	DATE: 1-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-1b

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG GOODSON

WEST

EAST

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-4

Pavement: 7" concrete

Stiff to very stiff, dark gray Lean Clay w/Sand (CL), with silt partings

-with siltstone fragments 0'-8', and ferrous nodules 0'-2'

-light gray 2'-4'

-with calcareous nodules 4'-10'

-tan and gray 8'-12'

-with fat clay pockets and seams 10'-12'

Firm to very stiff, red, brown, and light gray Fat Clay (CH), with slickensides

-with vertical silt partings 14'-16'

-with silty clay seams 16'-20'

-with siltstone fragments and calcareous and ferrous nodules 18'-20'

Very stiff, red, brown, and light gray Lean Clay w/Sand (CL), with silty clay seams, calcareous nodules, and siltstone fragments

-boring caved at 23' after drilling

Termination depth = 25 feet.

B-5

Pavement: 6.5" concrete

Fill: hard, dark gray Lean Clay w/ Sand (CL), with silt partings, siltstone fragments, and ferrous nodules

Firm to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings

-with siltstone fragments and calcareous nodules 2'-6'

-with ferrous nodules 6'-8'

-with silt pockets 8'-12'

-red, brown, and light gray, with fat clay partings 12'-13', wet at 12'

Termination depth = 13 feet.

B-6

Pavement: 7" concrete

Hard, gray and tan Lean Clay w/ Sand (CL), with silt partings, siltstone fragments, and calcareous and ferrous nodules

-with silt seams 6'-8'

Hard, red, brown, and light gray Lean Clay (CL), with slickensides and silt seams

-with fat clay partings 10'-12'

Termination depth = 13 feet.

B-7

Pavement: 7" concrete

Stiff to hard, gray and tan Lean Clay w/Sand (CL), with silt partings

-with silt pockets 0'-2'

-with abundant siltstone fragments 2'-6', and abundant calcareous nodules 2'-4'

-with silt pockets 4'-6'

-with silt seams 6'-8'

Very stiff to hard, red, light gray, and tan Fat Clay (CH), with slickensides

-with abundant calcareous nodules and siltstone fragments 12'-13'

Termination depth = 13 feet.

LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Depth of water first encountered during drilling
- Clayey sand
- Silty sand
- Depth of water ~15 min. after initial encounter
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Depth of water in piezometer 11/17/15
- Silty low plasticity clay
- Silt

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.: G166-14	DATE: 1-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-2a

GENERALIZED SUBSURFACE SOIL PROFILE

CONTINUED ALONG GOODSON

WEST

EAST

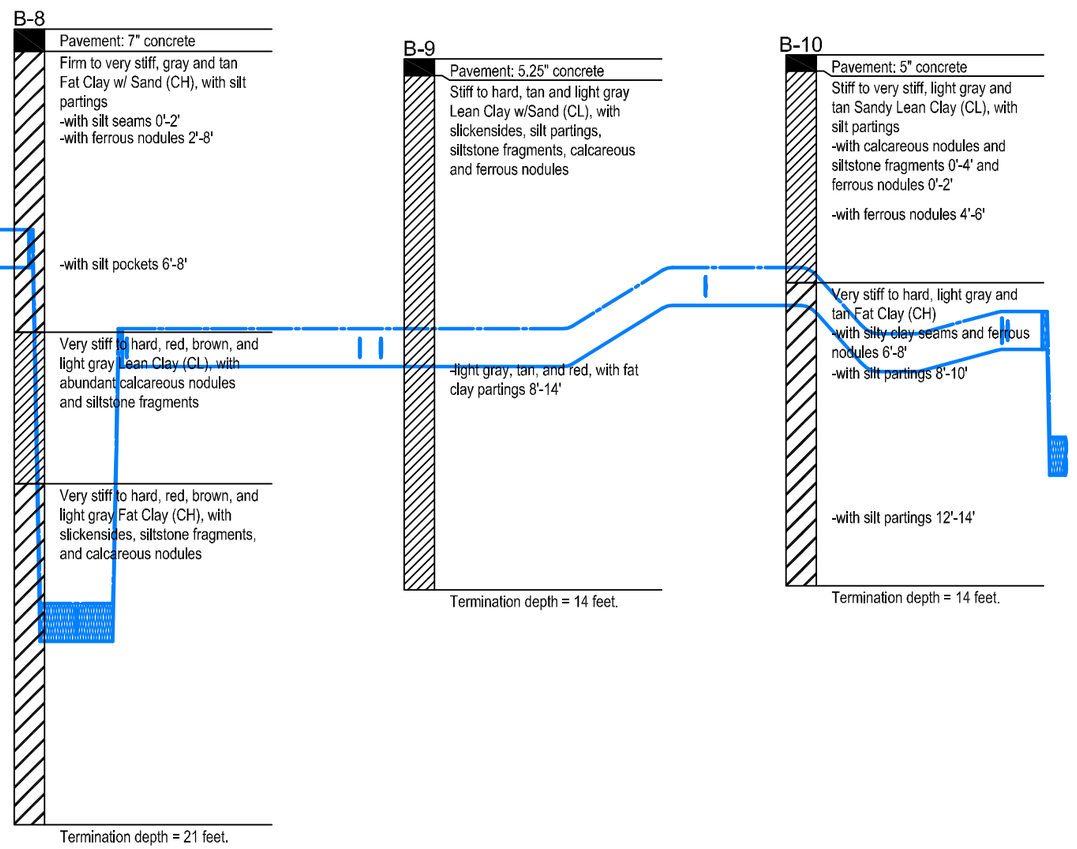
BASELINE STATIONS

20+00 22+00 24+00 26+00 28+00 30+00 32+00 34+00 36+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

Paving	Fill		
High plasticity clay	Low plasticity clay	Depth of water first encountered during drilling	
Clayey sand	Silty sand	Depth of water ~15 min. after initial encounter	
Poorly graded silty clayey sand	Poorly graded sand with silt	Depth of water in piezometer 11/17/15	
Silty low plasticity clay	Silt		

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.: G166-14	DATE: 1-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-2b

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG CASA GRANDE (W)

WEST

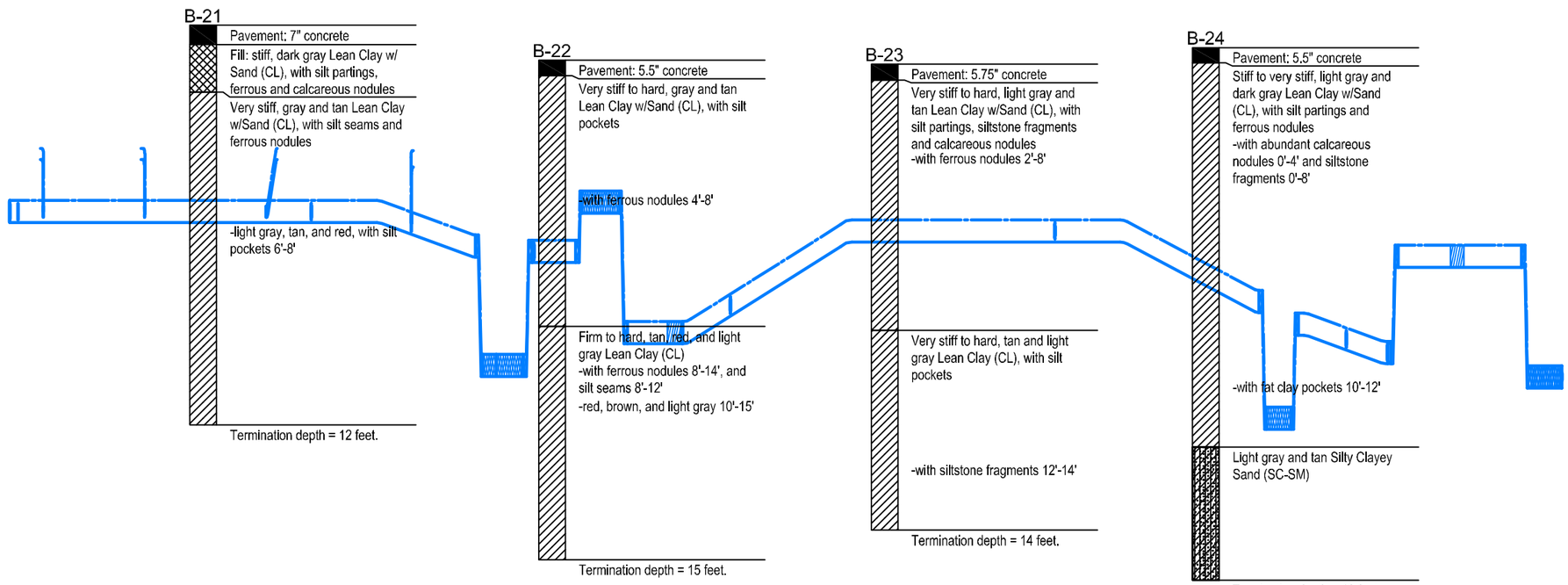
EAST

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Clayey sand
- Silty sand
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Silty low plasticity clay
- Silt
- Depth of water first encountered during drilling
- Depth of water ~15 min. after initial encounter
- Depth of water in piezometer 11/17/15

NOTE THERE IS A DISCREPANCY BETWEEN PROVIDED PLAN DRAWING AND PROFILE DRAWING BASELINE STATIONS. FOR THIS SOIL PROFILE SHEET, STATIONING FROM PLAN DRAWING IS USED.

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G166-14	1-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-3

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG GLAZEBROOK

WEST

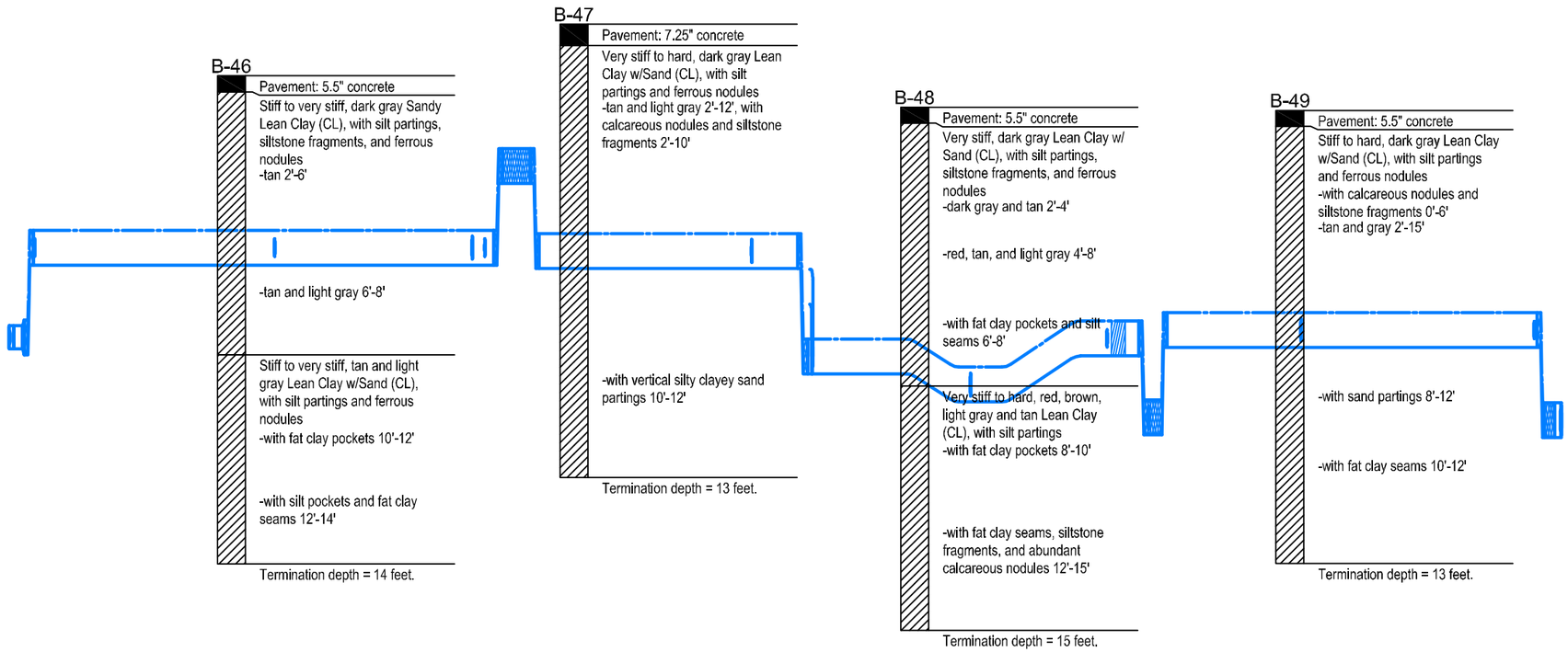
EAST

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Depth of water first encountered during drilling
- Clayey sand
- Silty sand
- Depth of water ~15 min. after initial encounter
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Depth of water in piezometer 11/17/15
- Silty low plasticity clay
- Silt

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.: G166-14	DATE: 1-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-4

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG DOGWOOD TREE

WEST

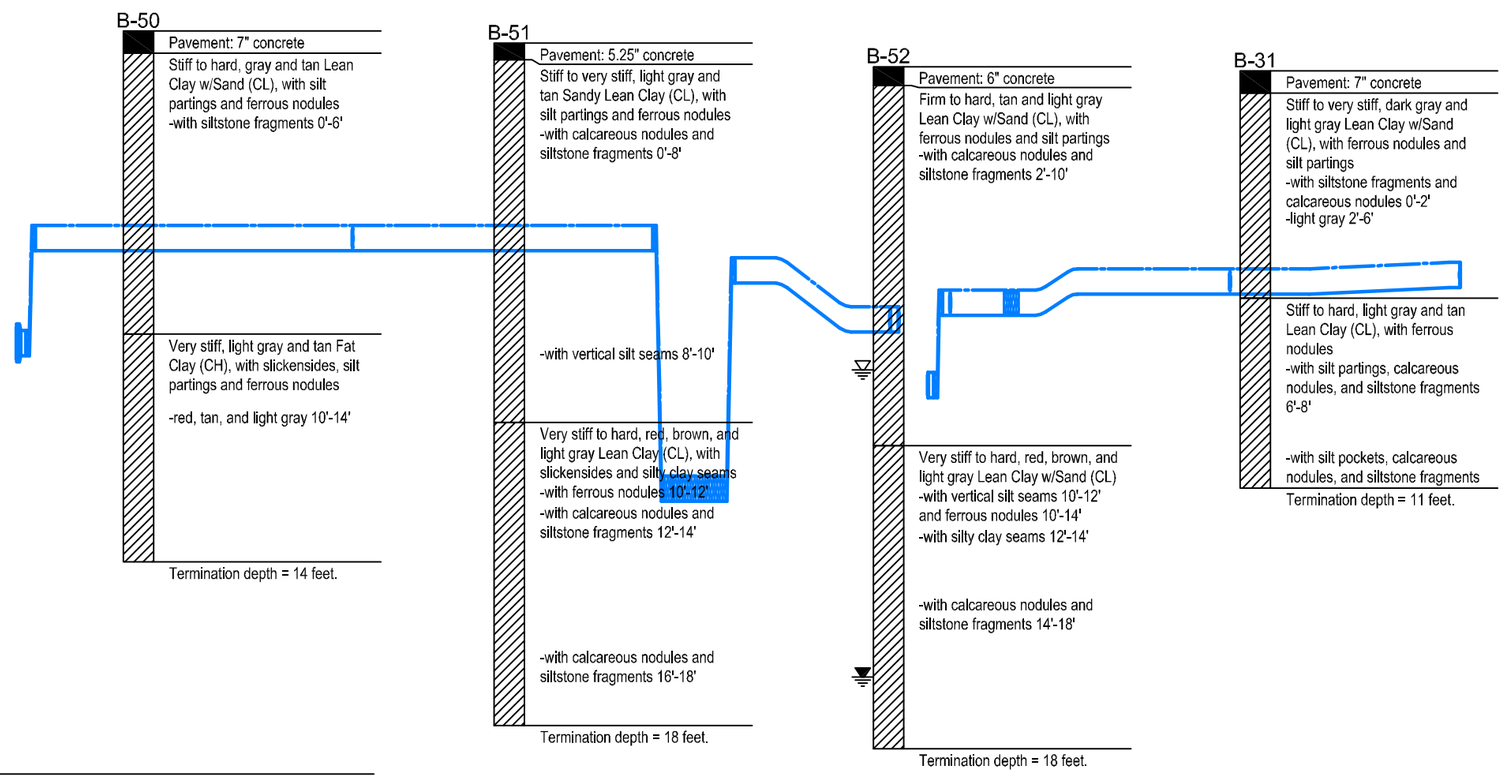
EAST

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- High plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- Silty low plasticity clay
- Fill
- Low plasticity clay
- Silty sand
- Poorly graded sand with silt
- Silt
- Depth of water first encountered during drilling
- Depth of water ~15 min. after initial encounter
- Depth of water in piezometer 11/17/15

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G166-14	1-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-5

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG IMPERIAL VALLEY

SOUTH

NORTH

BASELINE STATIONS

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-41

Pavement: 5.5" concrete

Stiff to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings and ferrous nodules
-with abundant calcareous nodules and siltstone fragments 0'-4'
-with silt seams 2'-4'

-with fat clay pockets 8'-10'

Hard, red, brown, and light gray Fat Clay (CH), with slickensides and silty clay seams
-with ferrous nodules 10'-12'
-with silt pockets, calcareous nodules, and siltstone fragments 12'-14'

Termination depth = 14 feet.

B-27

Pavement: 6" concrete

Fill: hard, light gray and tan Lean Clay (CL), with silt partings, ferrous and calcareous nodules, and siltstone fragments

Hard, light gray and tan Sandy Lean Clay (CL), with silt partings, ferrous and calcareous nodules, and siltstone fragments

Very stiff to hard, tan and light gray Lean Clay w/Sand (CL)
-with ferrous nodules 6'-8'

-with calcareous nodules and siltstone fragments 8'-12'

Termination depth = 12 feet.

B-13

Pavement: 5.5" concrete

Very stiff to hard, gray and tan Lean Clay w/Sand (CL), with silt pockets and ferrous nodules

Stiff to hard, tan and light gray Fat Clay (CH), with slickensides and ferrous nodules
-with silt seams 8'-10'
-brown, light gray, and red 10'-15'

-with silt partings 14'-15'

Termination depth = 15 feet.

B-8

Pavement: 7" concrete

Firm to very stiff, gray and tan Fat Clay w/ Sand (CH), with silt partings
-with silt seams 0'-2'
-with ferrous nodules 2'-8'

-with silt pockets 6'-8'

Very stiff to hard, red, brown, and light gray Lean Clay (CL), with abundant calcareous nodules and siltstone fragments

Very stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides, siltstone fragments, and calcareous nodules

Termination depth = 21 feet.

B-3

Pavement: 6" concrete

Hard, light gray and tan Sandy Lean Clay (CL), with silt partings, abundant siltstone fragments, calcareous and ferrous nodules

Red, brown, and light gray Clayey Sand (SC), with fat clay partings, abundant calcareous nodules and siltstone fragments
-with silty clay pockets 8'-10'

Termination depth = 13 feet.

LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Depth of water first encountered during drilling
- Clayey sand
- Silty sand
- Depth of water ~15 min. after initial encounter
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Depth of water in piezometer 11/17/15
- Silty low plasticity clay
- Silt

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G166-14	1-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' / HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-6

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG LA JOLLA

SOUTH

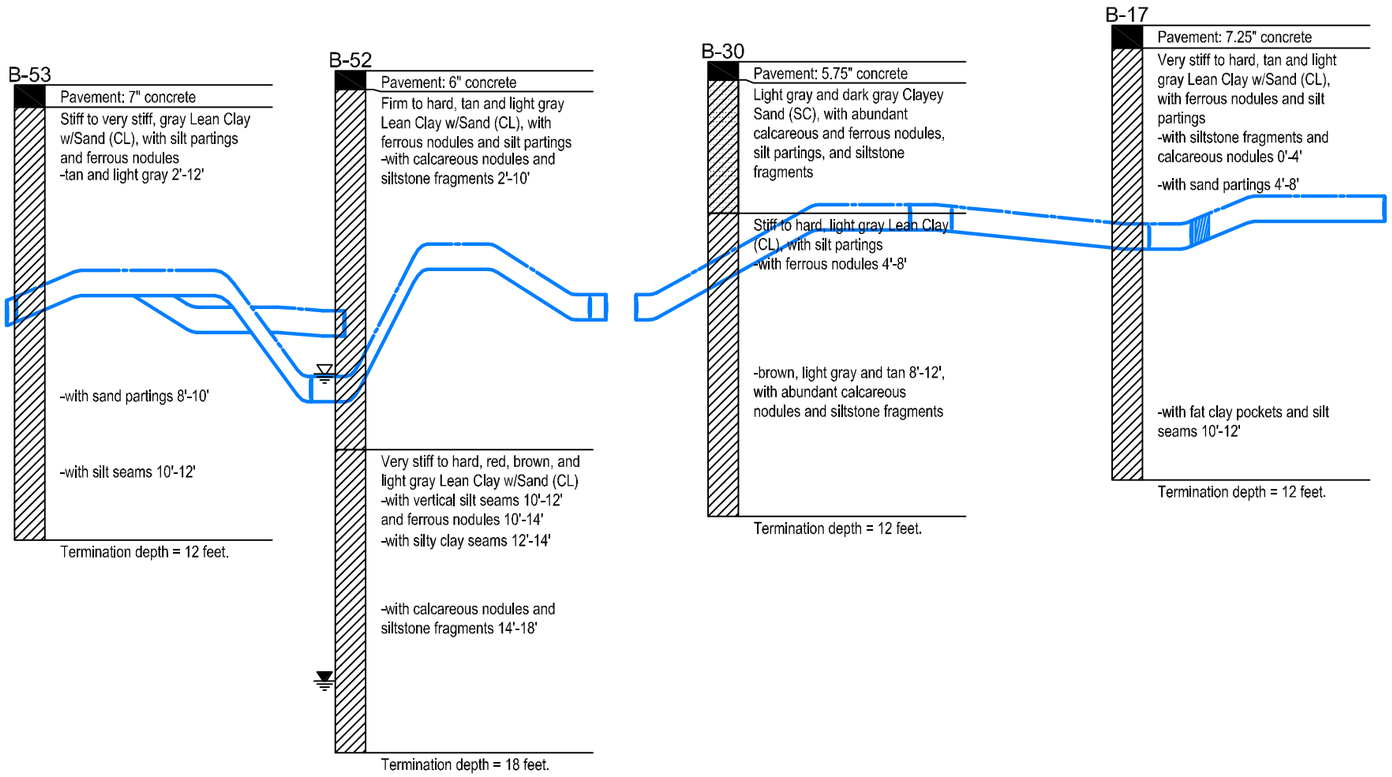
NORTH

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- Fill
- High plasticity clay
- Low plasticity clay
- Clayey sand
- Silty sand
- Poorly graded silty clayey sand
- Poorly graded sand with silt
- Silty low plasticity clay
- Silt
- Depth of water first encountered during drilling
- Depth of water ~15 min. after initial encounter
- Depth of water in piezometer 11/17/15

Note:

Soil stratigraphy and secondary soil structure (such as seams, layers, or pockets of sands or silts, slickensides, and fissures) that are different from what were identified in the actual borings may exist away from these borings.

AVILES ENGINEERING CORPORATION

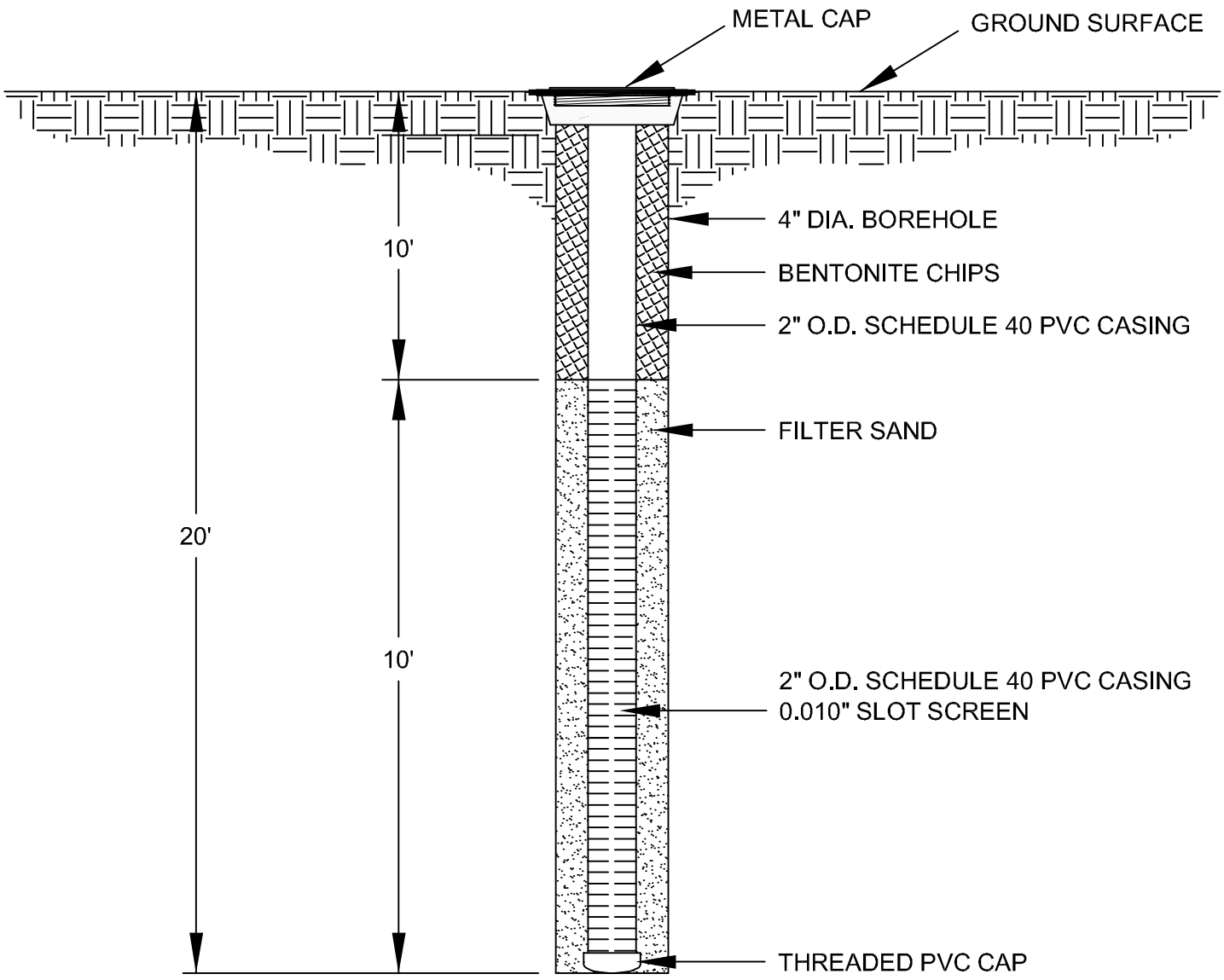
GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA

PACKAGE II, COH WBS NO. S-000035-0197-3

HOUSTON, TEXAS

AEC PROJECT NO.: G166-14	DATE: 1-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-7



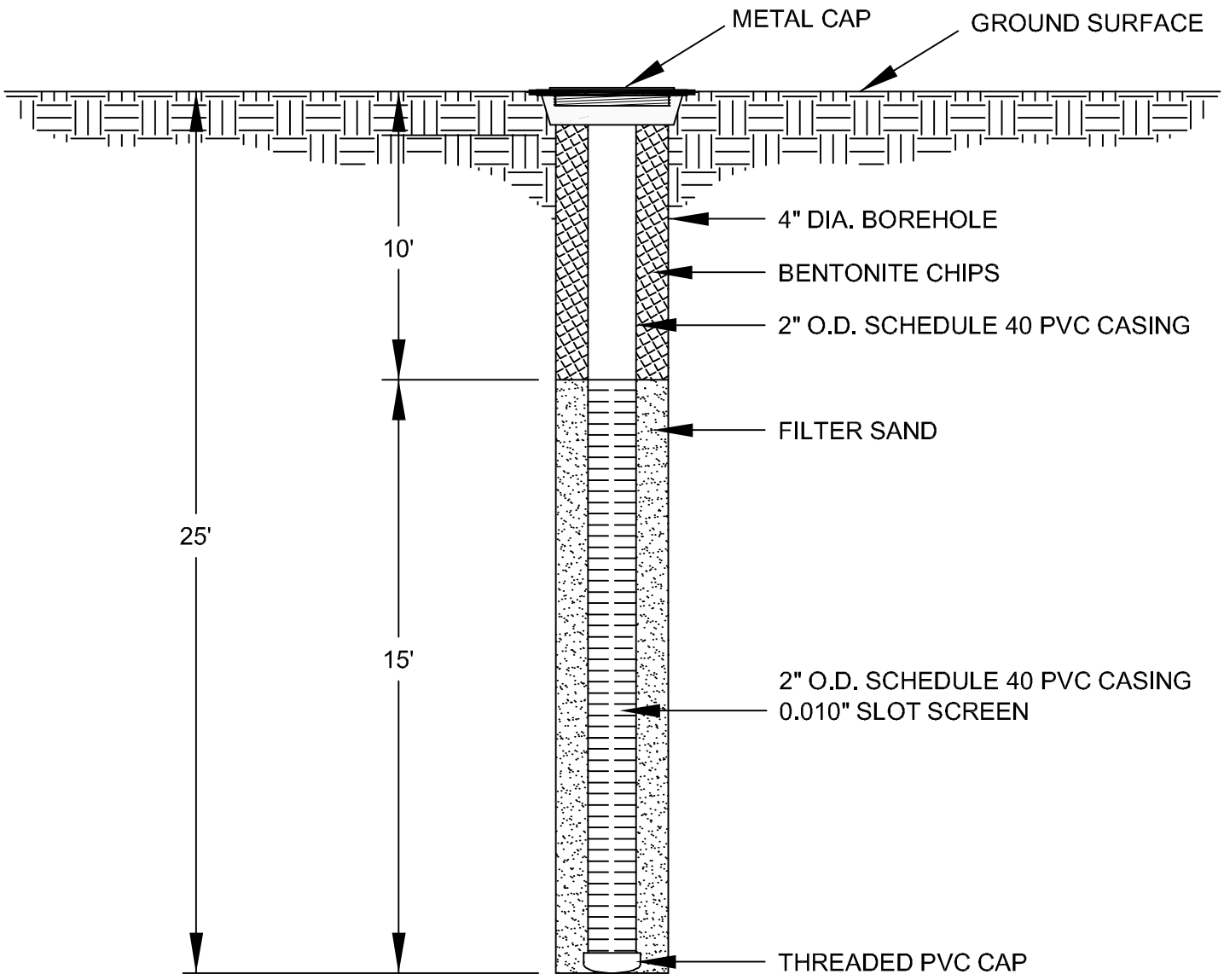
GROUNDWATER DEPTH FROM SURFACE:	DATE MEASURED:
8.34 FT	11/17/14

AVILES ENGINEERING CORPORATION

PIEZOMETER INSTALLATION DETAILS
BORING B-4 (PZ-1)

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DWG. BY:
G166-14	01-29-15	AVILES ENGINEERING CORP.
SCALE:	DRAWN BY:	PLATE NO.:
N.T.S.	BpJ	PLATE B-8



GROUNDWATER DEPTH FROM SURFACE:	DATE MEASURED:
10.60 FT	11/17/14

AVILES ENGINEERING CORPORATION

PIEZOMETER INSTALLATION DETAILS
BORING B-54 (PZ-2)

WATER LINE REPLACEMENT IN IMPERIAL VALLEY AREA
PACKAGE II, COH WBS NO. S-000035-0197-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DWG. BY:
G166-14	01-29-15	AVILES ENGINEERING CORP.
SCALE:	DRAWN BY:	PLATE NO.:
N.T.S.	BpJ	PLATE B-9

AVLES
ENGINEERING CORP.

APPENDIX C

Plates C-1 to C-6	Recommended Geotechnical Design Parameters
Plate C-7	Load Coefficients for Pipe Loading
Plate C-8	Live Loads on Pipe Crossing Under Roadway

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-1	0-8	Stiff to very stiff CL	133	71	B	1500	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	8-12	Very stiff CH	135	73	B	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
	12-16	Very stiff CH	135	73	C*	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-2	0-6	Stiff to very stiff CL	130	68	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-12	Very stiff to hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-3	0-4	Hard CL	133	71	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-8	Hard CL	133	71	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-13	SC	131	69	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-4	0-8	Stiff to very stiff CL	130	68	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	8-12	Stiff to very stiff CL	128	66	B	1100	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-16	Very stiff CH	120	58	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	16-22	Firm to very stiff CH	120	58	C* (16'-20')	700	0	1.00	1.00	1.00	50	16	0.57	0.72	1.76
	22-25	Very stiff CL	120	58	N/A	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-5	0-2	Fill: hard CL	120	58	C	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-8	Very stiff to hard CL	132	70	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-13	Firm to very stiff CL	120	58	C	900	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
B-6	0-4	Hard CL	135	73	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-13	Hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-7	0-4	Stiff to hard CL	134	72	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	4-8	Hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-13	Very stiff to hard CH	127	65	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-8	0-4	Firm to very stiff CH	130	68	C	800	0	1.00	1.00	1.00	75	16	0.57	0.72	1.76
	4-8	Very stiff CH	120	58	B	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	8-12	Very stiff to hard CL	128	66	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	12-20	Very stiff to hard CH	130	68	B	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
B-9	0-4	Stiff to very stiff CL	138	76	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	4-14	Very stiff to hard CL	132	70	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-10	0-6	Stiff to very stiff CL	138	76	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-14	Very stiff to hard CH	137	75	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-11	0-2	Stiff to very stiff CL	120	58	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	2-6	Firm to stiff CL	128	66	C	500	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
	6-14	Stiff to hard CL	132	70	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
B-12	0-6	Stiff to very stiff CL	136	74	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-10	Very stiff to hard CL	136	74	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	10-15	Very stiff CH	130	68	B	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
B-13	0-4	Very stiff to hard CL	138	76	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Stiff to hard CH	120	58	B	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
	12-15	Stiff to very stiff CH	124	62	B	1600	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
B-14	0-4	Stiff to very stiff CL	136	74	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	4-11	Very stiff to hard CL/CH	133	71	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-15	0-2	Fill: very stiff CL	135	73	C	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-6	Very stiff to hard CL	135	73	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	6-12	Stiff to very stiff CL	135	73	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
B-16	0-2	Very stiff to hard CL	136	74	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-6	Stiff to very stiff CL	136	74	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-12	Very stiff to hard CL	133	71	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	12-16	Firm to very stiff CL	133	71	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
B-17	0-4	Very stiff CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-12	Very stiff to hard CL	133	71	B	2100	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-18	0-8	Stiff to very stiff CL	131	69	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-12	Firm to very stiff CL	130	68	C	900	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
B-19	0-2	Pavement/Base	120	58	C										
	2-4	Fill: SC-SM	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	4-6	Soft to very stiff CL	123	61	C	300	0	1.00	1.00	1.00	25	18	0.53	0.69	1.89
	6-10	Stiff to very stiff CL	123	61	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	10-14	Very stiff to hard CL	130	68	C*	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-20	0-2	Pavement/Base	120	58	C										
	2-6	Firm to stiff CL	134	72	C	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	6-8	Very stiff CL	120	58	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-18	Very stiff to hard CH	127	65	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-21	0-2	Fill: stiff CL	120	58	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	2-12	Very stiff CL	132	70	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-22	0-4	Very stiff CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-12	Very stiff to hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	12-15	Firm to very stiff CL	128	66	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
B-23	0-4	Very stiff to hard CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-14	Very stiff to hard CL	137	75	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
B-24	0-8	Very stiff CL	136	74	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Stiff to very stiff CL	136	74	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-16	SC-SM	131	69	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-25	0-4	Hard CH	130	68	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	4-10	Very stiff CL	128	66	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	10-14	Stiff to hard CL	128	66	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-26	0-4	Very stiff CL	133	71	B	2100	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-12	Stiff to very stiff CL	132	70	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
B-27	0-2	Fill: hard CL	137	75	C	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-4	Hard CL	135	73	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-12	Very stiff to hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-28	0-6	Very stiff to hard CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-12	Very stiff to hard CL	132	70	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-29	0-4	Hard CL	135	73	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-8	Very stiff CL	135	73	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	Very stiff to hard CL	132	70	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-30	0-4	SC	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	4-6	Stiff to very stiff CL	132	70	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	6-12	Very stiff to hard CL	132	70	B	2750	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-31	0-4	Stiff to very stiff CL	136	74	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-11	Very stiff to hard CL	136	74	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-32	0-6	Firm to very stiff CL-ML	128	66	C	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	6-10	Very stiff CL	125	63	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	10-12	Firm to stiff CL	125	63	C	700	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-33	0-4	Stiff to very stiff CL	135	73	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	4-8	Very stiff to hard CL	135	73	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-16	Very stiff to hard CH	134	72	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-34	0-6	Hard CL	134	72	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-8	Stiff to very stiff CL	131	69	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-14	Very stiff CL	131	69	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-35	0-6	Hard CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-12	Stiff to very stiff CL	132	70	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-36	0-6	Stiff to very stiff CL	135	73	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-11	Very stiff to hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-37	0-4	Very stiff CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-12	Very stiff CL	135	73	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
B-38	0-2	Very stiff to hard CL	138	76	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-4	Stiff CL	120	58	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	4-8	Soft to stiff CL-ML	120	58	C	400	0	1.00	1.00	1.00	25	18	0.53	0.69	1.89
	8-10	Stiff CL-ML	120	58	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	10-14	Very stiff CH	120	58	B	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-39	0-8	Very stiff to hard CL	133	71	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-16	Very stiff to hard CL/CH	133	71	B	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-40	0-8	Stiff to very stiff CL	133	71	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-14	Very stiff CH	131	69	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-41	0-4	Very stiff to hard CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-10	Stiff to hard CL	133	71	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	10-14	Hard CH	120	58	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-42	0-4	Hard CL	133	71	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-11	Hard CL	133	71	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-43	0-4	Stiff to hard CL	139	77	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	4-12	Very stiff CL	132	70	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-44	0-6	Very stiff CL	135	73	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-12	Stiff to very stiff CH	132	70	B	1200	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	12-14	Hard CH	120	58	B	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-45	0-8	Stiff to very stiff CL	135	73	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-16	Very stiff to hard CH	133	71	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-46	0-6	Very stiff CL	132	70	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-14	Stiff to very stiff CL	128	66	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-47	0-6	Very stiff to hard CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-13	Very stiff to hard CL	134	72	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-48	0-8	Very stiff CL	131	69	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-15	Very stiff to hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-49	0-4	Stiff to very stiff CL	136	74	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	4-13	Very stiff to hard CL	137	75	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-50	0-6	Stiff to very stiff CL	131	69	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-14	Very stiff to hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-51	0-6	Stiff to very stiff CL	137	75	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	6-12	Very stiff CL	133	71	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-18	Very stiff to hard CL	131	69	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-52	0-4	Firm to stiff CL	127	65	C	600	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
	4-8	Stiff to very stiff CL	127	65	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	8-18	Very stiff to hard CL	133	71	C*	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
B-53	0-2	Stiff CL	120	58	C	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	2-6	Stiff to very stiff CL	135	73	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-12	Very stiff CL	133	71	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-54	0-4	Very stiff CL	120	58	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	4-10	Stiff to very stiff CL	132	70	B	1100	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	10-16	Very stiff to hard CL	133	71	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	16-20	Stiff to very stiff CL/CH	125	63	C*	1100	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	20-25	Stiff CL	120	58	N/A	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
B-55	0-2	Fill: hard CL-ML	120	58	C	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-6	Stiff CL	136	74	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	6-10	Very stiff CL	139	77	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-20	Very stiff to hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	20-25	Very stiff CL-ML	120	58	N/A	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89

G166-14 WATER LINE REPLACEMENT IN IMPERIAL VALLEY PACKAGE II, HOUSTON, TEXAS
SOIL PARAMETERS FOR UNDERGROUND UTILITIES

(1) γ = Unit weight for soil above water level, γ' = Buoyant unit weight for soil below water level.

(2) C = Soil ultimate cohesion for short term (upper limit of 3,000 psf for design purposes), φ = Soil friction angle for short term;

(3) C' = Soil ultimate cohesion for long term (upper limit of 300 psf for design purposes), φ' = Soil friction angle for long term;

(4) K_a = Coefficient of active earth pressure, K_0 = Coefficient of at-rest earth pressure, K_p = Coefficient of passive earth pressure;

(5) CL = Lean Clay, CH = Fat Clay, CL-ML = Silty Clay, SC-SM = Silty Clayey Sand, SC = Clayey Sand.

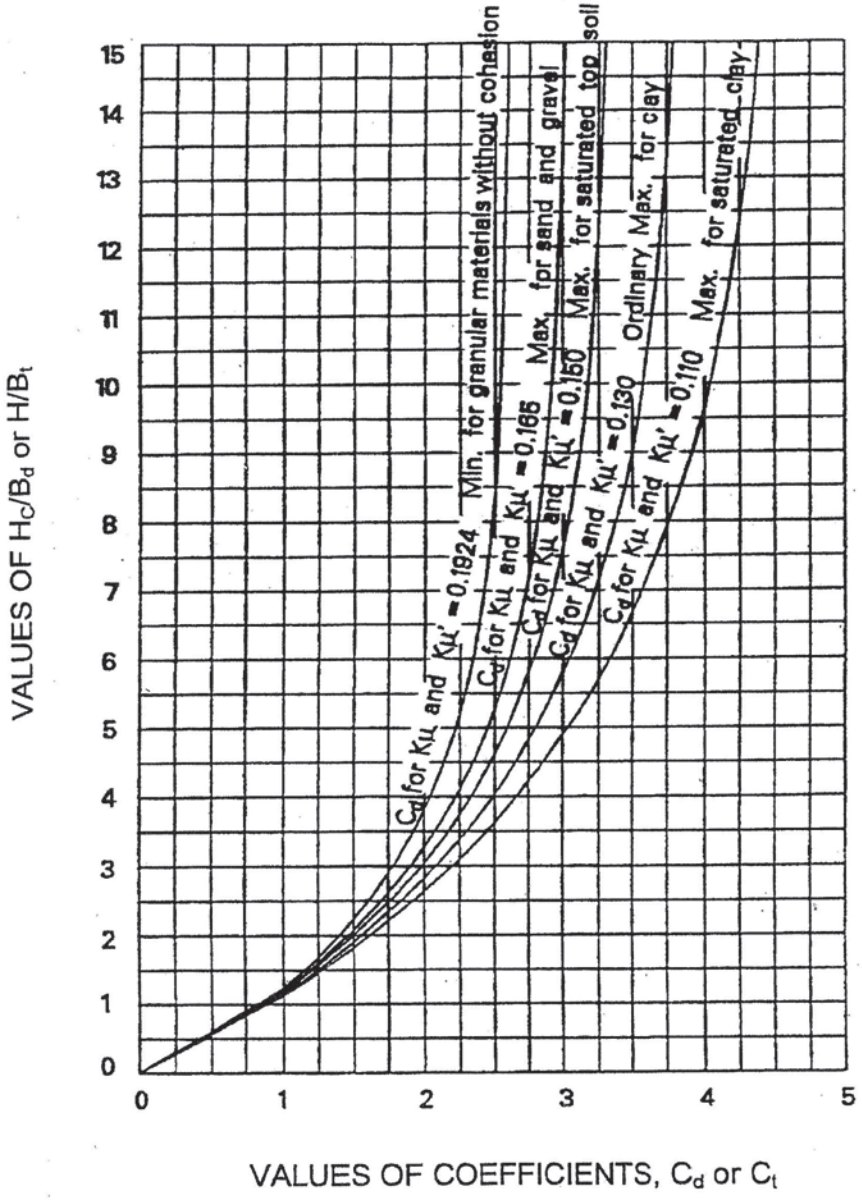
(6) OSHA Soil Types for soils in the top 20 feet below grade:

A: cohesive soils with qu = 1.5 tsf or greater (qu = Unconfined Compressive Strength of the Soil)

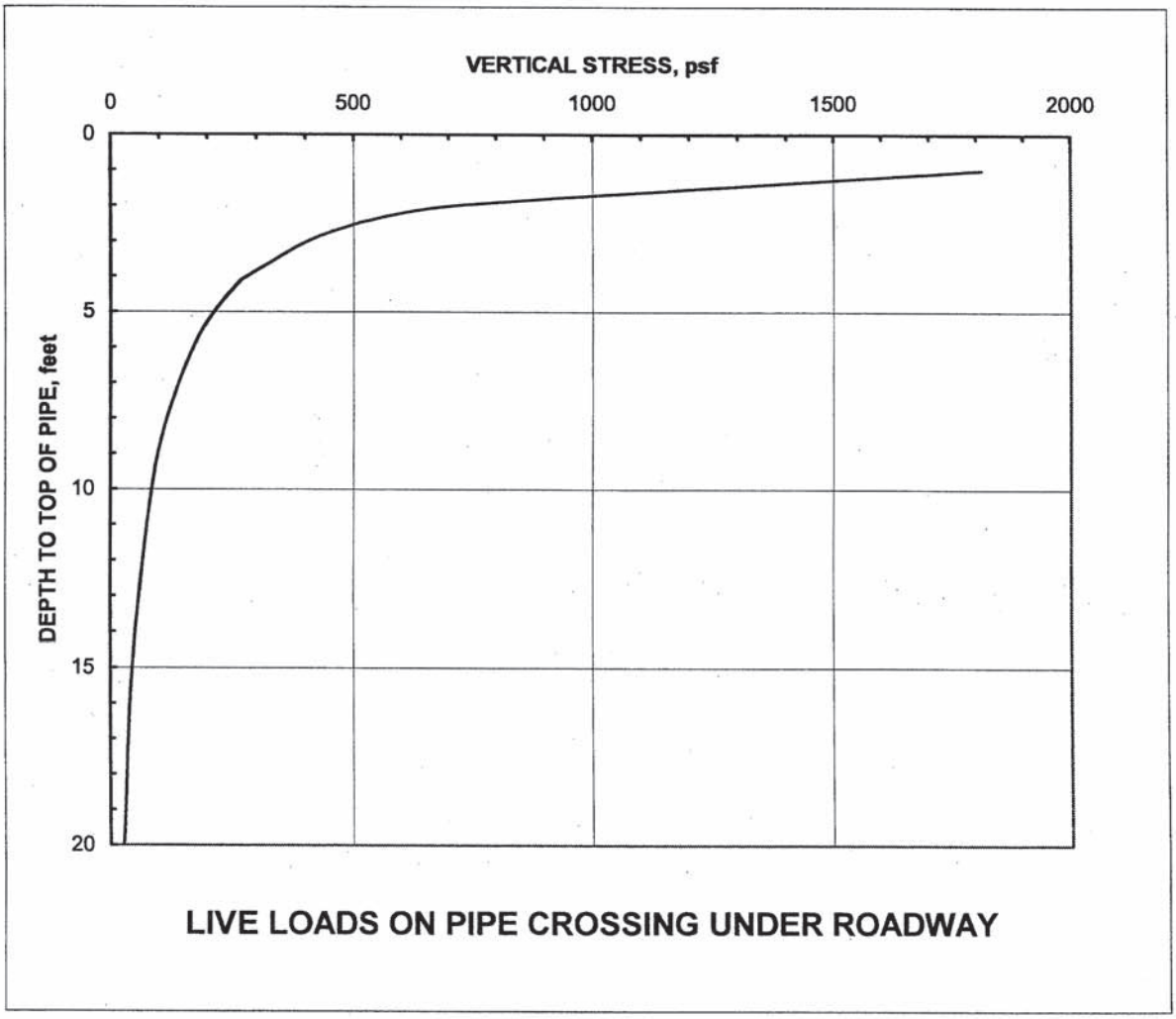
B: cohesive soils with qu = 0.5 tsf or greater

C: cohesive soils with qu = less than 0.5 tsf, fill materials, or granular soil

C*: submerged cohesive soils; dewatered cohesive soils can be considered OSHA Type C.



Reference: US Army Corps of Engineers Engineering Manual, EM 1110-2-2902, Oct. 31, 1997, Figure 2-5.



LIVE LOADS ON PIPE CROSSING UNDER ROADWAY

Note: 1. The vertical stress was estimated using AASHTO HS20 truck axle loadings on paved surfaces (Reference: ASCE 15-98, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standandard Installations").
2. Single truck passing.

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APPENDIX D

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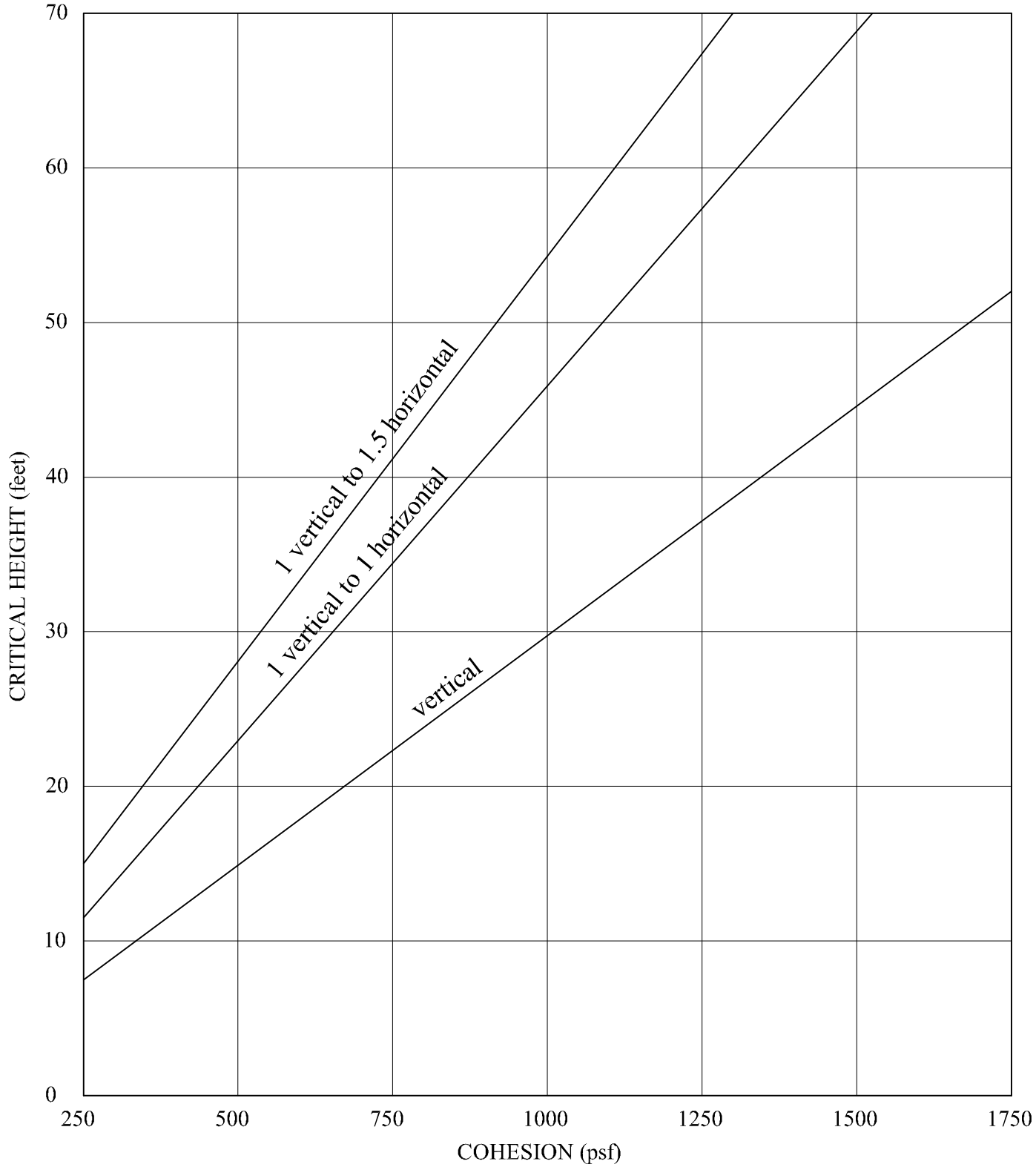
Critical Heights of Cut Slopes in Nonfissured Clays



Note: The charts are calculated based on NAVFAC DM7.1, Page 7.1-319, assuming the critical circles are toe circles, and wet unit weight of soils = 125pcf.

PLATE D-1

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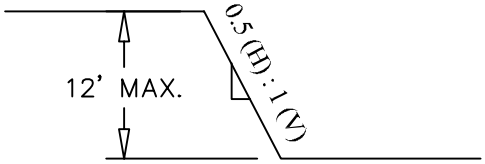
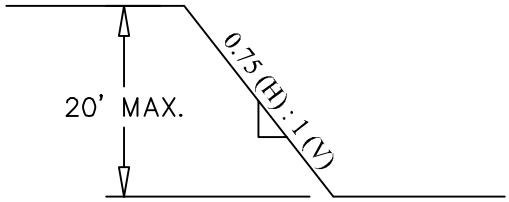
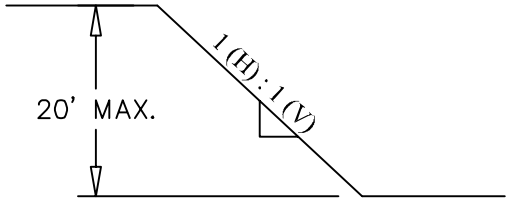
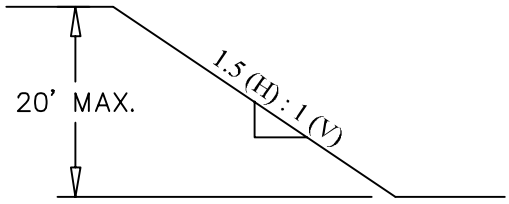
MAXIMUM ALLOWABLE SLOPES

	SHORT TERM	LONG TERM
TYPE A SOILS		
TYPE B SOILS	N/A	
TYPE C SOILS	N/A	

NOTES:

(1) For Type A soils, a short term maximum allowable slope of 0.5 (H) : 1 (V) is allowed in excavations that are 12 feet or less in depth; short term (24 hours or less) maximum allowable slopes for excavations greater than 12 feet in depth shall be 0.75 (H) : 1 (V).

(2) Maximum depth for above slopes is 20 feet. For slopes deeper than 20 feet, trench protection should be designed by the Contractor's professional engineer.

Reference: OSHA, Safety and Health Regulations for Construction, 1926 Subpart P.

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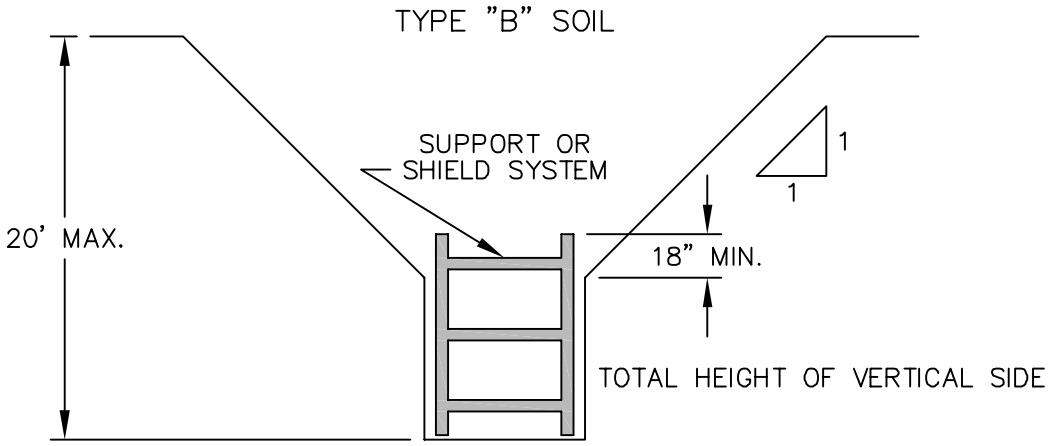
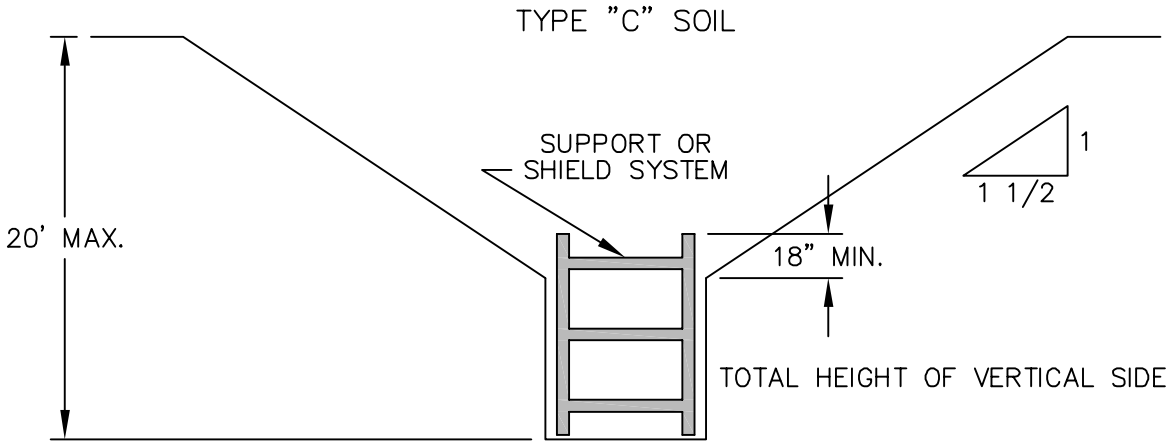
A COMBINATION OF BRACING AND OPEN CUTS





Reference: OSHA, Safety and Health Regulations for Construction, 1926 Subpart P.

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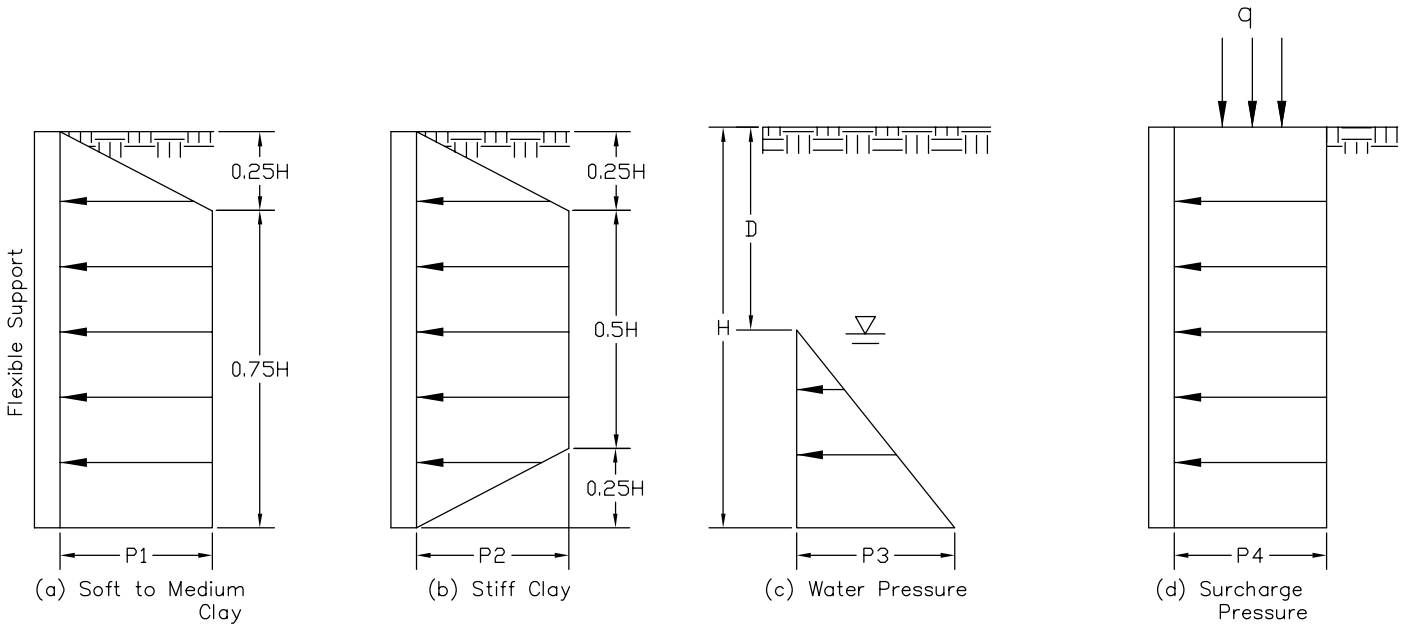
LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - LONG TERM CONDITIONS



Empirical Pressure Distributions

Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = γH-4C, psf
P2 = Lateral earth pressure = 0.4γH, psf
P3 = Water pressure = γ_w (H-D), psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
C = Drained shear strength or cohesion, psf
K_a = Coefficient of active earth pressure

Notes:
1. All pressures are additive.
2. No safety factors are included.
3. For use only during long term construction.
4. If γH/C < 4, use section (b),
   If 4 < γH/C < 6, use larger of section (a) or (b),
   If γH/C > 6, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

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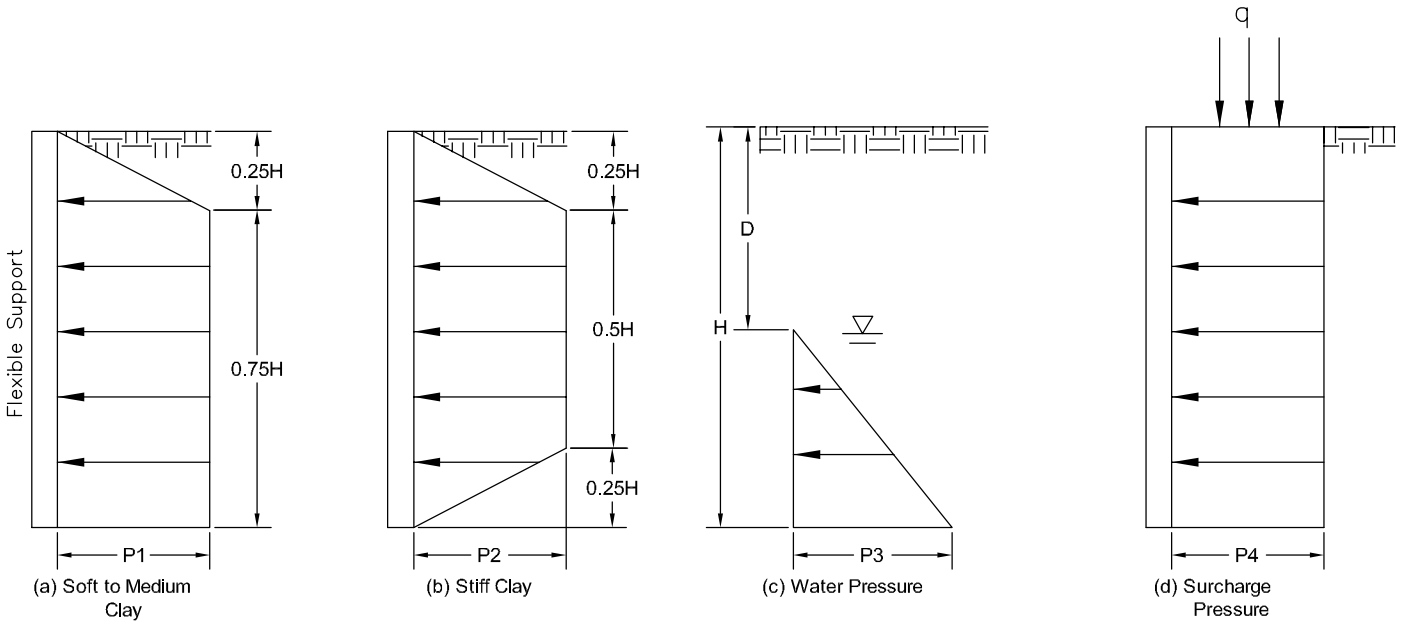
LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - SHORT TERM CONDITIONS



Empirical Pressure Distributions

Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $\gamma H - 4S_u$, psf
P2 = Lateral earth pressure = $0.2\gamma H$, psf
P3 = Water pressure = $\gamma_w (H-D)$, psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
S_u = Undrained shear strength = $q_u/2$, psf
q_u = Unconfined compressive strength, psf
K_a = Coefficient of active earth pressure

Notes:
1. All pressures are additive.
2. No safety factors are included.
3. For use only during short term construction.
4. If $\gamma H/S_u < 4$, use section (b),
   If $4 < \gamma H/S_u < 6$, use larger of section (a) or (b),
   If $\gamma H/S_u > 6$, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

AYLES
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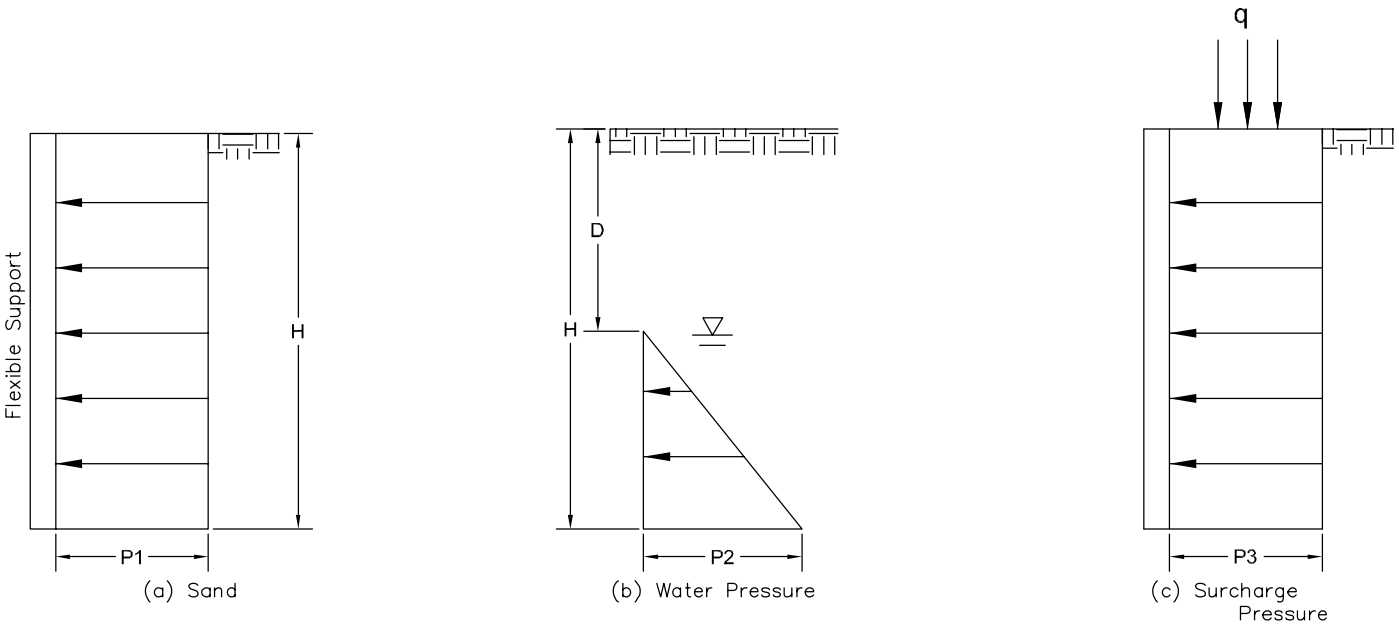
LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN SAND



Empirical Pressure Distributions

Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $0.65*\gamma HK_a$, psf
P2 = Water pressure = γ_w (H-D), psf
P3 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
K_a = Coefficient of active earth pressure = $(1-\sin\varphi)/(1+\sin\varphi)$
φ = Drained friction angle

Notes:
1. All pressures are additive.
2. No safety factors are included.

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

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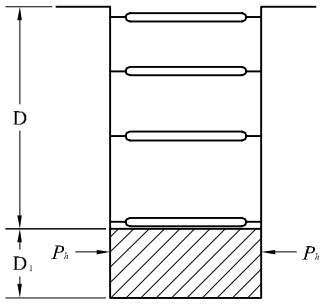
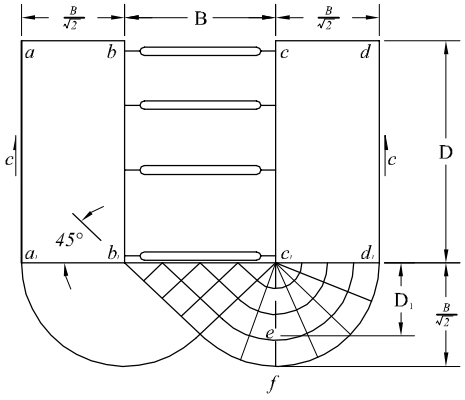
BOTTOM STABILITY FOR BRACED EXCAVATION IN CLAY





Factor of Safety against bottom of heave,

$$F.S = \frac{NcC}{(\gamma D + q)}$$

where, Nc = Coefficient depending on the dimension of the excavation (see Figure at the bottom)
C = Undrained shear strength of soil in zone immediately around the bottom of the excavation,
γ = Unit weight of soil,
D = Depth of excavation,
q = Surface surcharge.

If F.S < 1.5, sheeting should be extended further down to achieve stability

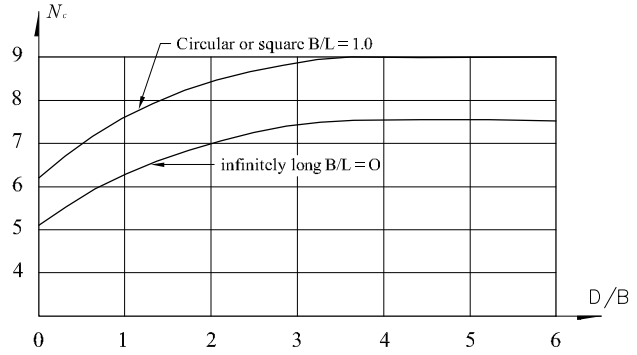
$$\text{Depth of Buried Length, } (D_1) = \frac{1.5(\gamma D + q) - NcC}{(C/B) - 0.5\gamma} \; ; \; D_1 \geq 5 \text{ ft.}$$

Pressure on buried length, P_h:

For $D_1 < 0.47B$; $P_h = 1.5\, D_1(\gamma D - 1.4\, CD/B - 3.14C)$

For $D_1 > 0.47B$; $P_h = 0.7\, (\gamma DB - 1.4\, CD - 3.14CB)$

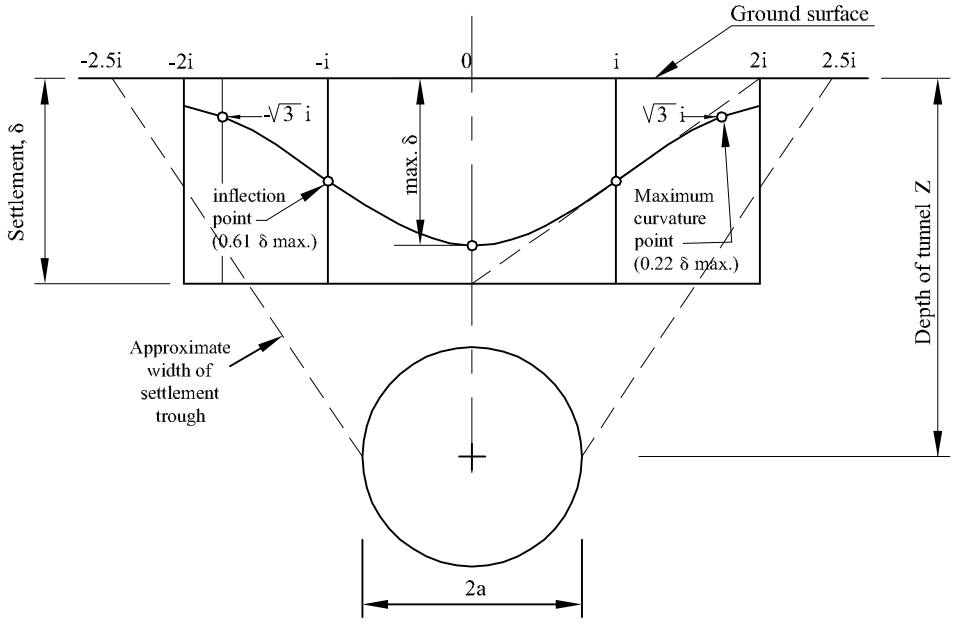
where; B = width of excavation



N_c rectangular = $(0.84 + 0.16B/L)N_c$ square

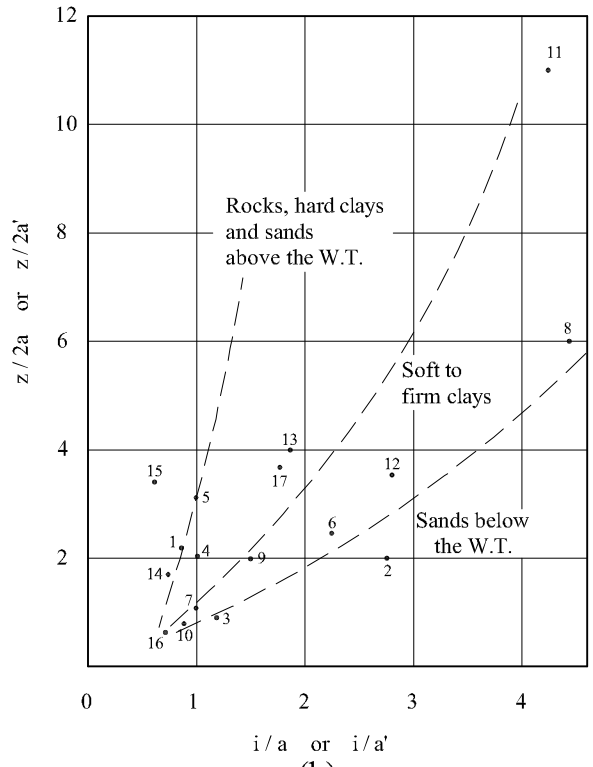
Reference: Bjerrum, L. and Eide, O., Stability of Strutted Excavations in Clay, Geotechnique, 6, 32-47 (1956).

Relation between the Width of the Surface Depression (i/a) and the Depth of the Cavity (z/a) for Tunnels



Volume of depression = 2.5i δ max.

(a)



(b)

Reference: Peck, R. B. (1969) "Deep Excavations and Tunneling in Soft Ground," Proceedings, Seventh International Conference on Soil Mechanics and Foundation Engineering, Mexico City, State of the Art Volume, pp. 225-290.

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APPENDIX E

Plates E-1 to E-3	Old Creek Road (N) Waterline Bridge Driven Pile Capacities
Plate E-4	Old Creek Road (N) Waterline Bridge LPile Parameters

G166-14 Imperial Valley Waterline Replacements
Old Creek Road (N) Waterline Bridge Driven Piles (Borings B-54 and B-55)

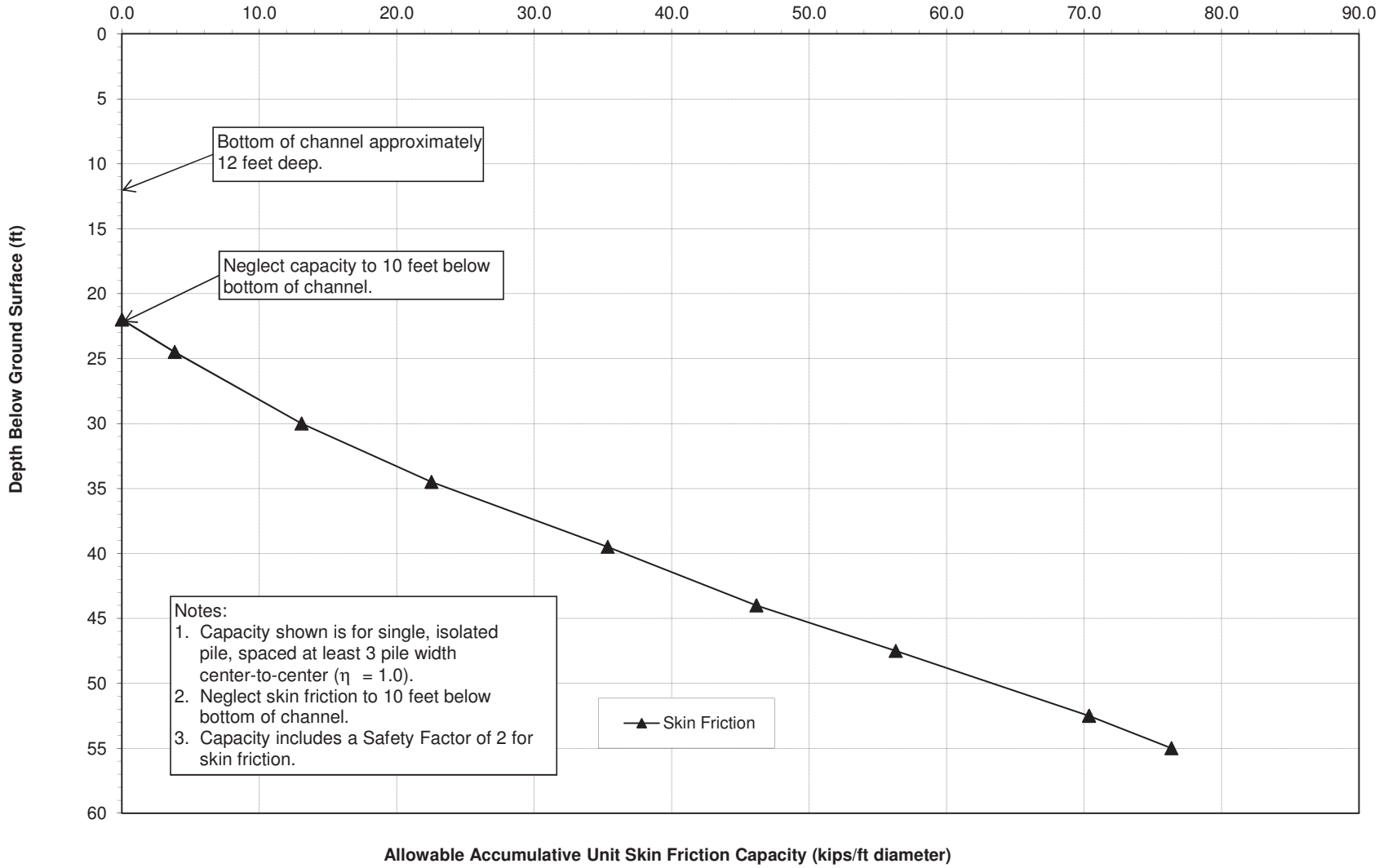

PLATE E-1

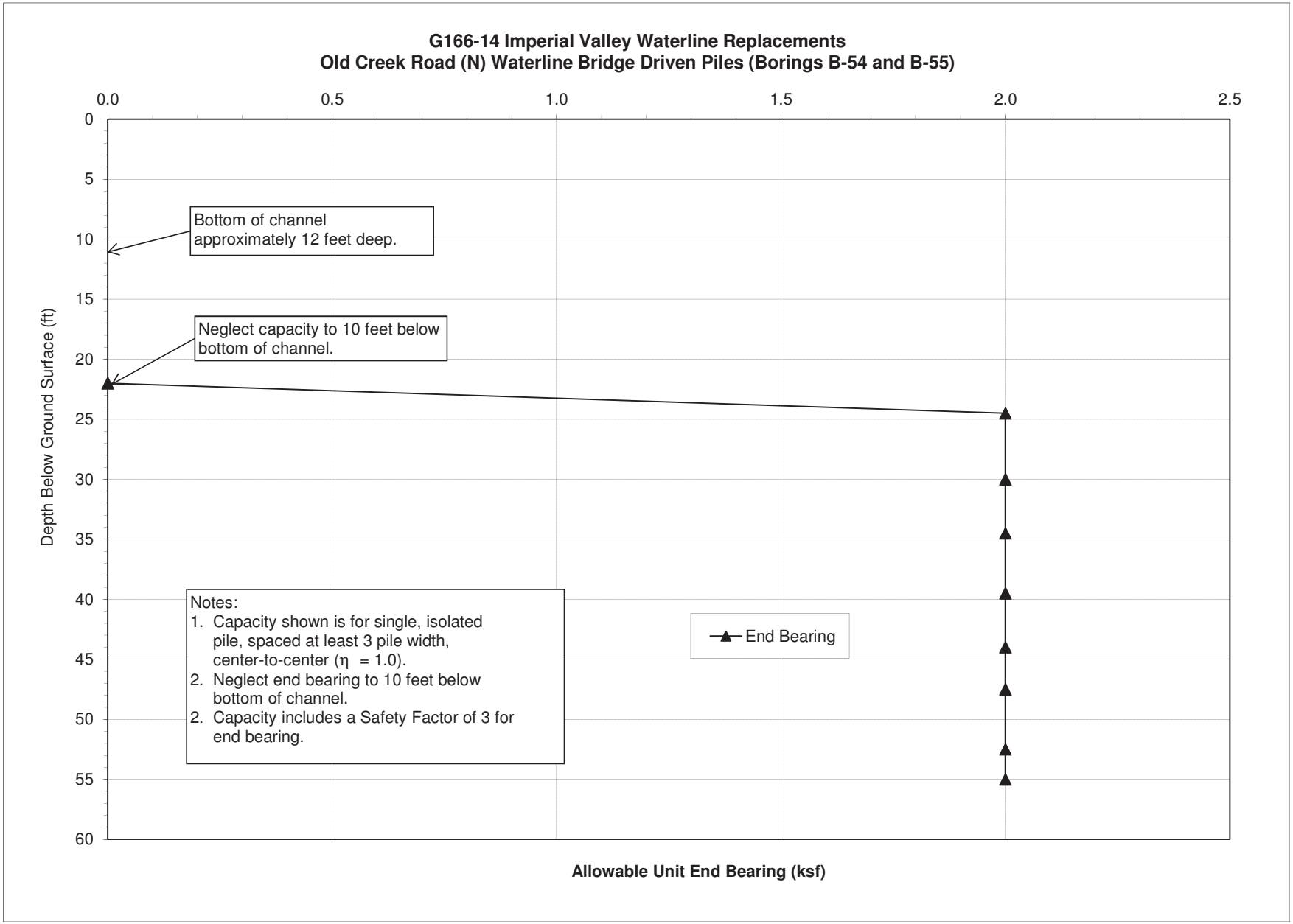
G166-14 Imperial Valley Waterline Replacements
Old Creek Road (N) Waterline Bridge Driven Piles (Borings B-54 and B-55)
0.0
0.5
1.0
1.5
2.0
2.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Depth Below Ground Surface (ft)
Bottom of channel approximately 12 feet deep.
Neglect capacity to 10 feet below bottom of channel.
Notes:
1. Capacity shown is for single, isolated pile, spaced at least 3 pile width, center-to-center (η = 1.0).
2. Neglect end bearing to 10 feet below bottom of channel.
2. Capacity includes a Safety Factor of 3 for end bearing.
End Bearing
Allowable Unit End Bearing (ksf)

PLATE E-2

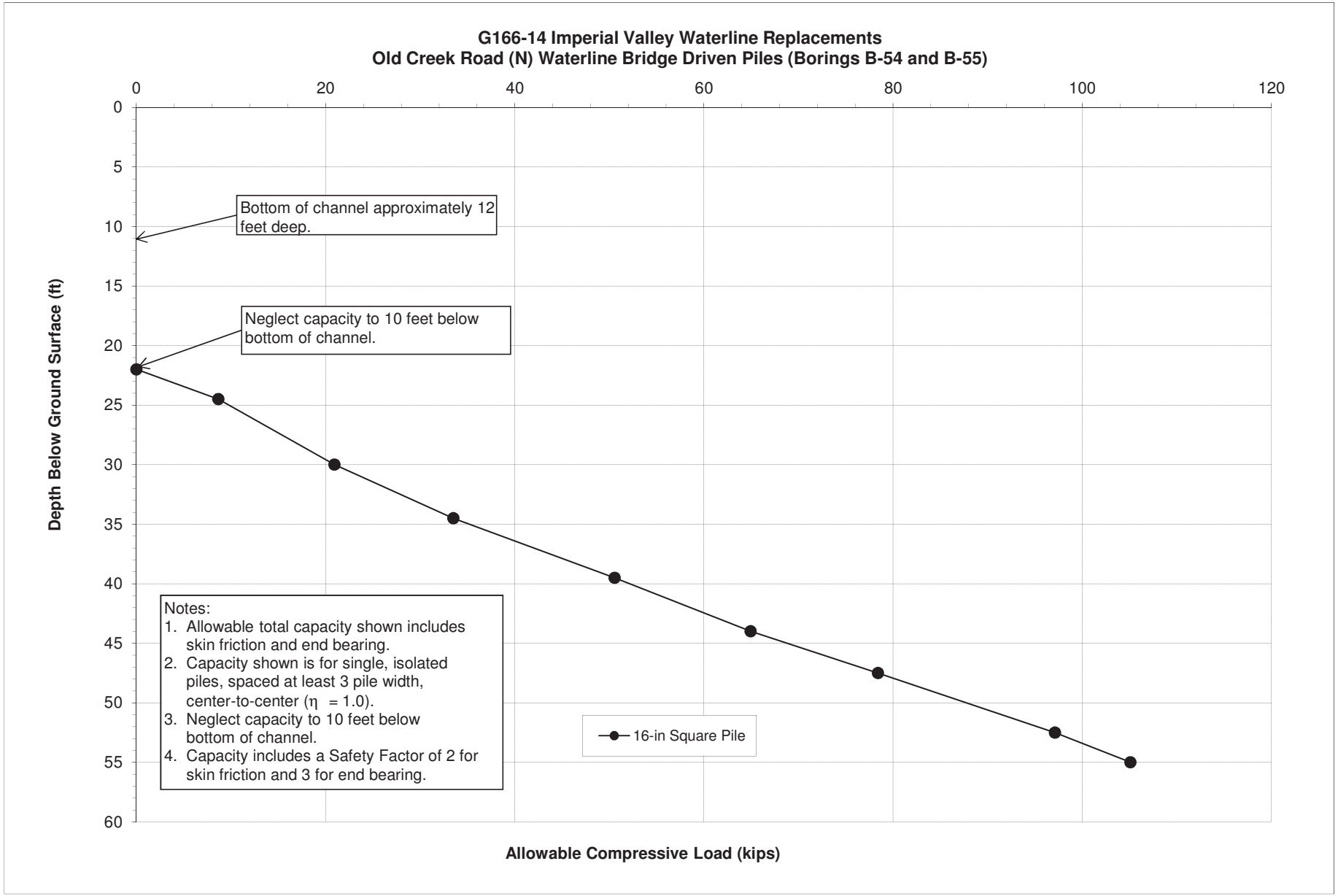
G166-14 Imperial Valley Waterline Replacements
Old Creek Road (N) Waterline Bridge Driven Piles (Borings B-54 and B-55)
Depth Below Ground Surface (ft)
Allowable Compressive Load (kips)
0
20
40
60
80
100
120
0
5
10
15
20
25
30
35
40
45
50
55
60
Bottom of channel approximately 12 feet deep.
Neglect capacity to 10 feet below bottom of channel.
Notes:
1. Allowable total capacity shown includes skin friction and end bearing.
2. Capacity shown is for single, isolated piles, spaced at least 3 pile width, center-to-center (η = 1.0).
3. Neglect capacity to 10 feet below bottom of channel.
4. Capacity includes a Safety Factor of 2 for skin friction and 3 for end bearing.
16-in Square Pile

PLATE E-3

Table 1. LPile Parameters
Old Creek Road (N) Waterline Bridge Driven Piles (Borings B-54 and B-55)

Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	C_u (psf)	φ_u (deg.)	ε_{50}	k (pci)
0 to 3	Weak Soil	120	58	200	0	0.02	20
3 to 8	Stiff to very stiff CL	132	70	1,100	0	0.009	125
8 to 14	Very stiff to hard CL	133	71	2,600	0	0.005	300
14 to 21	Stiff to hard CL/CH	125	63	1,200	0	0.008	150
21 to 27	Stiff CL	120	58	1,000	0	0.009	100
27 to 33	Very stiff to hard CL	120	58	1,600	0	0.008	190
33 to 36	Very stiff to hard CH	125	63	3,400	0	0.005	400
36 to 43	Hard CL-ML	120	58	0	34	-	125
43 to 45	Very stiff CL	120	58	2,400	0	0.005	300

Note: (1) Depth below existing grade;
(2) γ= wet unit weight of soil, γ'= buoyant unit weight of soil;
(3) C_u = cohesion, ϕ_u = angle of internal friction, refer to unconsolidated-undrained test;
(4) ε_{50} = strain at 50% of maximum stress, k = cyclic soil modulus;
(5) CL= Lean Clay; CH = Fat Clay, CL-ML = Silty Clay.

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APPENDIX F

Plate F-1	Soil Parameters for Slope Stability Analysis
Plates F-2 to F-3	Slope Stability Analysis, Impact of Waterline Bridge Construction along Old Creek (N) crossing HCFCD Unit P144-01-00, Short Term (Construction Phase Only) Conditions

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Table 1. Design Soil Parameters for Slope Stability Analyses
South Bank Channel P144-01-00 (Based on Boring B-54)

Elevation (ft)	Soil Type	γ (pcf)	Short-Term (UU)	
			C_u (psf)	ϕ_u (deg)
Varies	Concrete Liner	150	1,000(4)	0
80 to 70	Stiff to very stiff CL	132	1,100	0
70 to 64	Very stiff to hard CL	133	2,800	0
64 to 55	Stiff to hard CL/CH	125	1,100	0

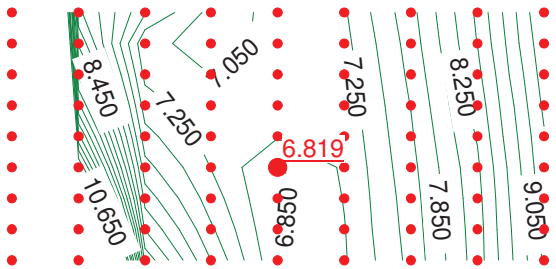
Notes: (1) γ= wet unit weight of soil;
(2) C_u =undrained cohesion,ϕ_u = angle of internal friction, under short term conditions. UU = strength parameters that were determined from Unconsolidated-Undrained triaxial tests;
(3) CH = fat clay, CL= Lean Clay.
(4) Maximum shear strength for concrete liner in accordance with HCFCD requirements.

Table 2. Design Soil Parameters for Slope Stability Analyses
North Bank Channel P144-01-00 (Based on Boring B-55)

Elevation (ft)	Soil Type	γ (pcf)	Short-Term (UU)	
			C_u (psf)	ϕ_u (deg)
Varies	Concrete Liner	150	1,000(4)	0
80 to 78	Fill: hard CL-ML	120	1,000	0
78 to 74	Stiff to very stiff CL	136	1,200	0
74 to 70	Stiff to very stiff CL	139	2,200	0
70 to 60	Very stiff to hard CL	136	3,000	0
60 to 55	Stiff to very stiff CL-ML	120	1,500	0

Notes: (1) γ= wet unit weight of soil;
(2) C_u =undrained cohesion,ϕ_u = angle of internal friction, under short term conditions. UU = strength parameters that were determined from Unconsolidated-Undrained triaxial tests;
(3) CH = fat clay, CL= Lean Clay, CL-ML = Silty Clay.
(4) Maximum shear strength for concrete liner in accordance with HCFCD requirements.

G166-14 WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA
IMPACT OF WATERLINE BRIDGE CONSTRUCTION ON SLOPE STABILITY
OLD CREEK (N) ROAD AT HCFCD UNIT P144-01-00, BASED ON BORINGS B-54 & B-55
NORTH BANK, SHORT TERM (CONSTRUCTION PHASE) CONDITION



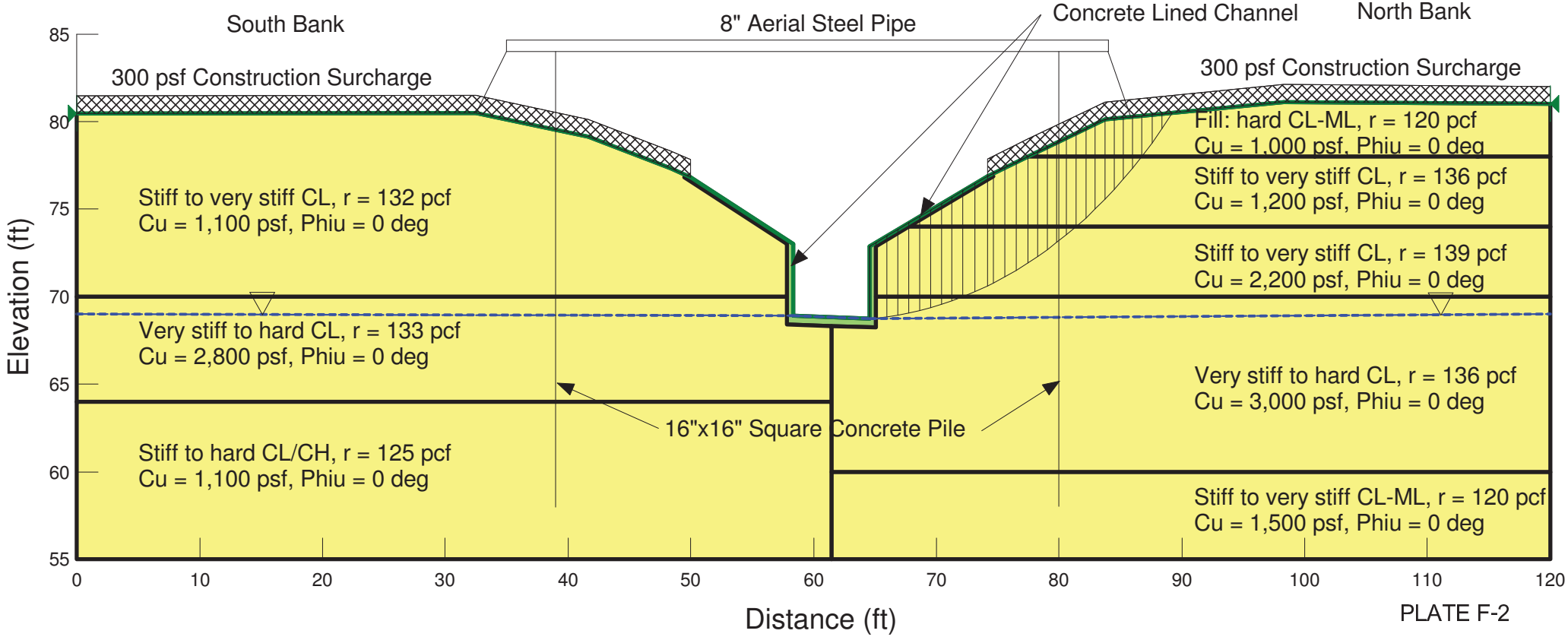
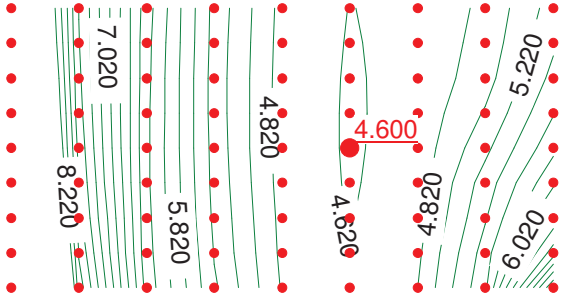


PLATE F-2

G166-14 WATERLINE REPLACEMENT IN IMPERIAL VALLEY AREA
IMPACT OF WATERLINE BRIDGE CONSTRUCTION ON SLOPE STABILITY
OLD CREEK (N) ROAD AT HCFCD UNIT P144-01-00, BASED ON BORINGS B-54 & B-55
SOUTH BANK, SHORT TERM (CONSTRUCTION PHASE) CONDITION



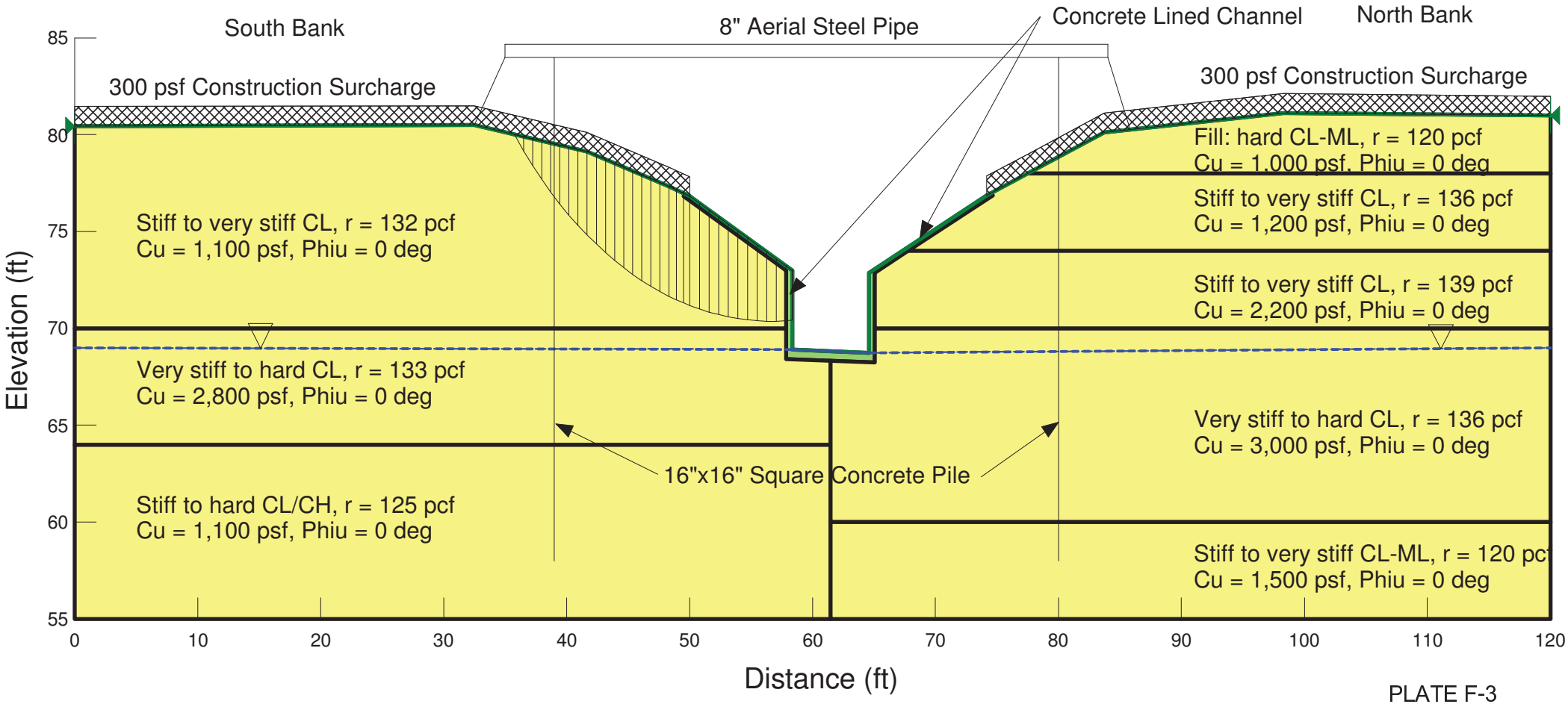


PLATE F-3

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APPENDIX G

Plates G-1 to G-4 Piezometer Installation and Plugging Reports

STATE OF TEXAS WELL REPORT for Tracking #414610

Owner:	**Aviles Engineering**	Owner Well #:	**B4(PZ-1)**
Address:	**5790 Windfern Houston, TX 77041**	Grid #:	**65-05-6**
		Latitude:	**29° 55' 30.22" N**
Well Location:	**Goodson Dr Houston, TX**	Longitude:	**095° 24' 30.21" W**
Well County:	**Harris**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **11/11/2014** Drilling End Date: **11/11/2014**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**4**	**0**	**20**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Screened**

Annular Seal Data: **No Data**

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **20/40 sand at 8 ft.**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Soltek LLC**

2338 Greenglade Ln
Spring, TX 77386

Driller Name: **Brian K Johnson** License Number: **59632**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	12	dark gray clay with sand
12	20	red, brown, and light gray fat clay

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	Riser	New Plastic (PVC)	40	0	10
2	Screen	New Plastic (PVC)	40 0.010	10	20

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #414611

Owner:	**Aviles Engineering**	Owner Well #:	**B54(PZ-2)**
Address:	**5790 Windfern Houston, TX 77041**	Grid #:	**65-05-6**
Well Location:	**Old Creek Rd Houston, TX**	Latitude:	**29° 55' 35.08" N**
		Longitude:	**095° 23' 52.35" W**
Well County:	**Harris**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **11/10/2014** Drilling End Date: **11/10/2014**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**2**	**0**	**25**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**13**	**Bentonite 1 Bags/Sacks**

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **20/40 sand at 13 ft.**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Soltek LLC**

2338 Greenglade Ln
Spring, TX 77386

Driller Name: **Brian K Johnson** License Number: **59632**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	25	red, brown,gray clay

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	Riser	New Plastic (PVC)	40	0	15
2	Screen	New Plastic (PVC)	40 0.010	15	25

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #155465

Owner:	**Aviles Engineering**	Owner Well #:	**B4(PZ-1)**
Address:	**5790 Windfern Houston, TX 77041**	Grid #:	**65-05-6**
Well Location:	**Goodson Dr Houston, TX**	Latitude:	**29° 55' 30.22" N**
		Longitude:	**095° 24' 30.21" W**
Well County:	**Harris**	Elevation:	**No Data**

Well Type: **Monitor**

Drilling Information

Company: **Soltek LLC** Date Drilled: **11/11/2014**

Driller: **Brian K Johnson** License Number: **59632**

Well Report Tracking #414610

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	**4**	**0**	**20**

Plugging Information

Date Plugged: **1/11/2016** Plugger:

Plug Method: **Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet**

Casing Left in Well:

Dia (in.)	Top (ft.)	Bottom (ft.)
2	**2**	**20**

Plug(s) Placed in Well:

Top (ft.)	Bottom (ft.)	Description (number of sacks & material)
0	**2**	**Concrete 1 Bags/Sacks**
2	**20**	**Bentonite 1 Bags/Sacks**

Certification Data: The driller certified that the driller plugged this well (or the well was plugged under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the reports(s) being returned for completion and resubmittal.

Company Information: **Soltek LLC**

2338 Greenglade Ln
Spring, TX 77386

Driller Name: **Brian K Johnson** License Number: **59632**

Comments: **No Data**

STATE OF TEXAS PLUGGING REPORT for Tracking #155464

Owner:	**Aviles Engineering**	Owner Well #:	**B54(PZ-2)**
Address:	**5790 Windfern Houston, TX 77041**	Grid #:	**65-05-6**
Well Location:	**Old Creek Rd Houston, TX**	Latitude:	**29° 55' 35.08" N**
		Longitude:	**095° 23' 52.35" W**
Well County:	**Harris**	Elevation:	**No Data**

Well Type: **Monitor**

Drilling Information

Company: **Soltek LLC** Date Drilled: **11/10/2014**

Driller: **Brian K Johnson** License Number: **59632**

Well Report Tracking #414611

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	**2**	**0**	**25**

Plugging Information

Date Plugged: **1/11/2016** Plugger:

Plug Method: **Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet**

Casing Left in Well:

Dia (in.)	Top (ft.)	Bottom (ft.)
2	**2**	**25**

Plug(s) Placed in Well:

Top (ft.)	Bottom (ft.)	Description (number of sacks & material)
0	**2**	**Concrete 1 Bags/Sacks**
2	**25**	**Bentonite 1.5 Bags/Sacks**

Certification Data: The driller certified that the driller plugged this well (or the well was plugged under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the reports(s) being returned for completion and resubmittal.

Company Information: **Soltek LLC**

2338 Greenglade Ln
Spring, TX 77386

Driller Name: **Brian K Johnson** License Number: **59632**

Comments: **No Data**