AVILES
ENGINEERING CORP.

GEOTECHNICAL INVESTIGATION

CITY OF HOUSTON
WATER LINE REPLACEMENT IN
SHARPSTOWN COUNTRY CLUB ESTATES AREA
COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

Reported to:
KCI Technologies, Inc.
Houston, Texas

by

Aviles Engineering Corporation
5790 Windfern
Houston, Texas 77041
713-895-7645

REPORT NO. G110-13

June 2015

AVILES
ENGINEERING CORP.

June 26, 2015

Mr. Dan Simeone, P.E.
KCI Technologies, Inc.
801 Travis Street, Suite 2000
Houston, Texas 77002

Reference: **Geotechnical Investigation**
Waterline Replacement in Sharpstown Country Club Estates Area
WBS No.: S-000035-0173-3
Houston, Texas
AEC Report No. G110-13

Dear Mr. Simeone,

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 May 29, 2014 by Ms. Gwendolyn Richardson, P.E., Project Engineer of KCI Technologies, Inc. (formerly ESPA Corp), based on AEC's proposal G2014-03-12R2, dated May 7, 2014.

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.
Principal Engineer

Reports Submitted: 3 KCI Technologies, Inc.
1 File (electronic)

Z:\ENGINEERING\REPORTS\2013\110-13 SHARPSTOWN COUNTRY CLUB ESTATES WATER MAIN REPLACEMENT - ESPA (WILBER)\G110-13 FINAL.DOCX

AVLES
ENGINEERING CORP.

TABLE OF CONTENTS

AVLES
ENGINEERING CORP.

APPENDICES

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

AVILES
ENGINEERING CORP.

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 Sharpstown area, in Houston, Texas (Houston Key Map 530 A, B, C, F, and G). Based on 90 percent complete drawings (dated April 9, 2015) provided to AEC by KCI Technologies., approximately 27,340 linear feet of existing 6 to 12 inch diameter waterlines will be replaced with new 8 to 12 inch waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 4.7 to 21.1 feet below grade.

1. Subsurface Soil Conditions: Generalized subsurface profiles along selected alignments are presented on Plates B-1 through B-18, in Appendix B.

   Based on Borings B-47 through B-99, the subsurface conditions at the site generally consists of 12 to 17 feet of firm to hard lean/fat clay (CL/CH) at the ground surface, underlain by 1 to to 11 feet of loose to medium dense clayey/silty sand (SC/SM) to the boring termination depths. Approximately 2 feet of very stiff lean clay (CL) fill was encountered at the ground surface of Boring B-83.

2. Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have medium to very high plasticity, with liquid limits (LL) ranging from 28 to 68, and plasticity indices (PI) ranging from 8 to 49. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. The cohesive soils encountered are classified as "CL" and "CH" type soils and granular soils were classified as "SC", "SM", "SP-SM", and "SC-SM" in accordance with ASTM D 2487.

3. Groundwater Conditions: Groundwater was encountered in Borings B-54, B-56, B-58, B-63, B-69, B-72, B-77, B-81, B-84, B-86 through B-88, B-90, B-93 through B-95, and B-97 during drilling at a depth of 8 to 17 feet and then rose to a depth of 8 to 14 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.

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

AVILES
ENGINEERING CORP.

GEOTECHNICAL INVESTIGATION

CITY OF HOUSTON
WATER LINE REPLACEMENT IN
SHARPSTOWN COUNTRY CLUB ESTATES AREA
COH WBS NO. S-000035-0173-3
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 Sharpstown area, in Houston, Texas (Houston Key Map 530 A, B, C, F, and G). A vicinity map is presented on Plate A-1, in Appendix A. Based on 90 percent complete drawings (dated April 9, 2015) provided to AEC by KCI Technologies, approximately 27,340 linear feet of existing 6 to 12 inch diameter waterlines will be replaced with new 8 to 12 inch waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 4.7 to 21.1 feet below grade.

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 53 geotechnical borings, ranging from 12 to 24 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. Construction recommendations for installation of waterlines by auger methods.

AVLES
ENGINEERING CORP.

2.0 SUBSURFACE EXPLORATION

2.1 Soil Borings

Boring spacing and depths were selected in accordance with Chapter 11 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 53 soil borings (Borings B-47 through B-99) ranging from 12 to 24 feet below existing grade. Borings B-1 through B-46 were drilled for the adjacent Waterline Replacements in Gessner Area project, WBS No. S-000035-0154-4, AEC Report G109-13 (dated January 17, 2014).

The boring locations are shown on the Boring Location Plan on Plates A-2a and A-2b, in Appendix A. The total drilling footage is 766 feet. Boring survey data (including northing, easting, and surface elevation) is included on the boring logs. Information provided in this report is based on 90 percent complete plan and profile drawings (dated April 9, 2015) provided by KCI. The boring designations and depths, proposed waterline invert elevations (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)	Station (Baseline)	Boring Surface Elevation (ft)	Invert Elevation at Boring /Nearest Crossing (ft)	Invert Depth at Boring/Nearest Crossing (ft)
B-47	Sands Point	13	17+08.49 (A)	67.69	61.18	6.51
B-48	Sands Point	17	21+48.96 (A)	66.52	60.31 / 54.13	6.21 / 12.39
B-49	Sands Point	14	25+55.32 (A)	66.12	59.83 / 57.10	6.29 / 9.02
B-50	Sands Point	13	30+33.44 (A)	66.05	59.27 / 57.12	6.78 / 8.93
B-51	Sands Point	15	35+66.93 (A)	65.65	55.85	9.80
B-52	Sands Point	16	40+68.86 (A)	65.68	59.00 / 54.54	6.68 / 11.14
B-53	Sands Point	15	45+79.80 (A)	65.33	56.11	9.22
B-54	Tam O'Shanter	15	1+71.89 (P)	63.97	56.68 / 54.64	7.29 / 9.33
B-55	Sands Point	14	55+82.43 (A)	65.08	57.60	7.48
B-56	Lugary	15	21+50.66 (R)	64.03	57.53 / 53.27	6.50 / 10.76
B-57	Gulfton	12	2+58.57 (S)	63.58	57.89	5.69
B-58	Gulfton	13	15+46.12 (E)	64.15	57.44	6.71

AVLES
ENGINEERING CORP.

Boring No.	Street	Boring Depth (ft)	Station (Baseline)	Boring Surface Elevation (ft)	Invert Elevation at Boring /Nearest Crossing (ft)	Invert Depth at Boring/Nearest Crossing (ft)
B-59	Gulfton	13	10+17.41 (E)	63.91	58.04 / 54.30	5.87 / 9.61
B-60	Gulfton	13	4+79.65 (E)	64.99	57.95	7.04
B-61	Osage	14	4+74.27 (N)	64.48	55.74	8.74
B-62	Osage	13	9+70.43 (N)	65.46	57.89	7.57
B-63	Prestwood	16	7+31.14 (C)	64.73	57.76 / 53.26	6.97 / 11.47
B-64	Prestwood	14	11+56.66 (C)	64.92	57.21	7.71
B-65	Green Ash	14	2+27.79 (O)	64.69	57.66	7.03
B-66	Prestwood	15	15+90.81 (C)	64.59	56.68 / 52.72	7.91 / 11.84
B-67	Prestwood	13	21+74.44 (C)	64.02	59.37	4.65
B-68	Green Ash	12	3+69.79 (D)	64.54	58.53	6.01
B-69	Tam O'Shanter	24	30+16.53 (Q)	64.84	57.32 / 43.76	7.52 / 21.08
B-70	Bellerive	12	2+21.49 (F)	63.95	57.84 / 53.44	6.11 / 10.51
B-71	Bellerive	13	7+91.38 (F)	63.91	57.35	6.56
B-72	Lugary	24	15+37.06 (R)	63.56	56.76 / 43.71	6.80 / 19.85
B-73	High Star	13	5+22.84 (G)	65.14	58.17	6.97
B-74	Tam O'Shanter	13	22+97.55 (Q)	64.36	57.88	6.48
B-75	Tam O'Shanter	12	18+44.89 (Q)	64.24	57.78	6.46
B-76	Moonmist	12	5+02.71 (H)	64.65	57.50	7.15
B-77	Lugary	17	9+48.58 (R)	63.69	50.78	12.91
B-78	Moonmist	13	11+80.60 (H)	64.49	57.14	7.35
B-79	Lugary	13	4+08.62 (R)	64.75	57.82 / 55.85	6.93 / 8.90
B-80	Hornwood	13	2+92.35 (I)	64.30	57.82	6.48
B-81	Tam O'Shanter	14	13+83.82 (Q)	64.60	57.32	7.28
B-82	Clarewood	18	7+50.87 (J)	64.15	56.72 / 50.50	7.43 / 13.65
B-83	Clarewood	15	11+90.81 (J)	64.55	56.00 / 51.69	8.55 / 12.86
B-84	Clarewood	15	15+70.85 (J)	64.57	57.07 / 51.69	7.50 / 12.88
B-85	Marinette	17	8+63.15 (T)	65.26	56.43 / 52.94	8.83 / 12.32
B-86	Marinette	15	3+93.87 (T)	66.99	57.83	9.16
B-87	De Moss	13	15+19.04 (K)	65.06	58.71	6.34

AVLES
ENGINEERING CORP.

Boring No.	Street	Boring Depth (ft)	Station (Baseline)	Boring Surface Elevation (ft)	Invert Elevation at Boring /Nearest Crossing (ft)	Invert Depth at Boring/Nearest Crossing (ft)
B-88	De Moss	12	11+67.65 (K)	65.44	58.97	6.47
B-89	De Moss	13	6+12.31 (K)	65.37	58.58	6.21
B-90	Tam O'Shanter	15	8+27.69 (Q)	65.06	57.09 / 56.00	7.97 / 9.06
B-91	Dashwood	14	2+28.94 (L)	65.07	59.28 / 56.37	5.79 / 8.70
B-92	Dashwood	13	7+28.29 (L)	65.33	59.11	6.22
B-93	Dashwood	15	11+69.47 (L)	66.02	60.11 / 57.30	5.91 / 8.72
B-94	Dashwood	14	17+46.31 (L)	66.73	60.32 / 58.00	6.41 / 8.73
B-95	Hiawatha	15	7+16.26 (M)	65.36	57.82	7.54
B-96	Hiawatha	14	2+29.05 (M)	65.29	57.36	7.93
B-97	Tam O'Shanter	17	3+26.97 (Q)	65.22	59.04 / 53.41	6.18 / 11.81
B-98	Allday	14	5+85.93 (B)	65.83	59.23	6.60
B-99	Allday	15	12+23.66 (B)	65.58	58.72	6.86

Note: (1) Based on 90 percent complete Plan and Profile drawings.

Existing concrete pavement at Borings B-47 through B-99 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.

AVLES
ENGINEERING CORP.

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 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-55, 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-56 through A-59, in Appendix A. A summary of lab test results is presented on Plates A-60 through A-72, 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-47	Sands Point	6.875” concrete
B-48	Sands Point	6” concrete, 8” stabilized clayey sand
B-49	Sands Point	6.75” concrete
B-50	Sands Point	6.5” concrete, 2” stabilized clayey sand
B-51	Sands Point	7” concrete, 11” stabilized clayey sand
B-52	Sands Point	7.25” concrete, 7.75” stabilized clayey sand
B-53	Sands Point	6.25” concrete
B-54	Tam O’Shanter	7” concrete
B-55	Sands Point	6” concrete
B-56	Lugary	6.125” concrete
B-57	Gulfton	1” asphalt, 7” concrete
B-58	Gulfton	6.25” concrete
B-59	Gulfton	6.25” concrete

Boring No.	Street	Pavement Section
B-60	Gulfton	6” concrete
B-61	Osage	6.75” concrete
B-62	Osage	6.5” concrete
B-63	Prestwood	6.25” concrete
B-64	Prestwood	6.5” concrete
B-65	Green Ash	6.25” concrete
B-66	Prestwood	6.5” concrete
B-67	Prestwood	7” concrete
B-68	Green Ash	5.75” concrete
B-69	Tam O’Shanter	6.75” concrete
B-70	Bellerive	6.375” concrete
B-71	Bellerive	6.5” concrete
B-72	Lugary	6.625” concrete
B-73	High Star	5.75” concrete
B-74	Tam O’Shanter	6.25” concrete
B-75	Tam O’Shanter	7” concrete
B-76	Moonmist	6.75” concrete
B-77	Lugary	6.5” concrete
B-78	Moonmist	6.75” concrete
B-79	Lugary	6.25” concrete
B-80	Hornwood	5.75” concrete
B-81	Tam O’Shanter	6.25” concrete
B-82	Clarewood	6.25” concrete
B-83	Clarewood	7.625” concrete
B-84	Clarewood	6.75” concrete
B-85	Marinette	7” asphalt, 4” lime-stabilized clayey sand
B-86	Marinette	4” asphalt, 6” stabilized clayey sand
B-87	De Moss	6.5” concrete, 7” stabilized gravel
B-88	De Moss	7.25” concrete
B-89	De Moss	6.25” concrete
B-90	Tam O’Shanter	5.5” concrete
B-91	Dashwood	6.625” concrete
B-92	Dashwood	5.5” concrete
B-93	Dashwood	6.25” concrete
B-94	Dashwood	7.25” concrete

Boring No.	Street	Pavement Section
B-95	Hiawatha	5.5” concrete
B-96	Hiawatha	6.25” concrete
B-97	Tam O’Shanter	6.375” concrete
B-98	Allday	7.375” concrete
B-99	Allday	6.125” concrete, 6.125” stabilized base

4.1 Subsurface Conditions

Generalized subsurface profiles along selected waterline alignments are presented on Plates B-1 through B-17, in Appendix B.

Based on Borings B-47 through B-99, the subsurface conditions at the site generally consists of 12 to 17 feet of firm to hard lean/fat clay (CL/CH) at the ground surface, underlain by 1 to 11 feet of loose to medium dense clayey/silty sand (SC/SM) to the boring termination depths. Approximately 2 feet of very stiff lean clay (CL) fill was encountered at the ground surface of Boring B-83. A summary of granular soils encountered in the borings is presented in Table 3.

Table 3. Granular Soils Encountered in Borings

Boring	Depth to Granular Soil	Granular Soil Type
B-51	14’ to 15’	Silty Clayey Sand (SC-SM)
B-54	10’ to 15’	Clayey Sand (SC)
B-55	11’ to 14’	Clayey Sand (SC)
B-56	14’ to 15’	Silty Clayey Sand (SC-SM)
B-58	12’ to 13’	Clayey Sand (SC)
B-59	8’ to 13’	Clayey Sand (SC)
B-63	12’ to 16’	Clayey Sand (SC)
B-69	13’ to 18’ 18’ to 24’	Silty Clayey Sand (SC-SM) Medium dense, Poorly Graded Sand w/Silt (SP-SM)
B-71	12’ to 13’	Clayey Sand (SC)
B-72	10’ to 16’ 16’ to 23’	Clayey Sand (SC) Poorly Graded Sand w/Silt (SP-SM)

Boring	Depth to Granular Soil	Granular Soil Type
B-74	12’ to 13’	Clayey Sand (SC)
B-77	12’ to 17’	Clayey Sand (SC)
B-84	12’ to 15’	Clayey Sand (SC)
B-85	8’ to 17’	Clayey Sand (SC)
B-86	6’ to 12’ 12’ to 15’	Clayey Sand (SC) Silty Sand (SM)
B-90	8’ to 15’	Clayey Sand (SC)
B-94	12’ to 14’	Clayey Sand (SC)

Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have medium to very high plasticity, with liquid limits (LL) ranging from 28 to 68, and plasticity indices (PI) ranging from 8 to 49. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. The cohesive soils encountered are classified as “CL” and “CH” type soils and granular soils were classified as “SC”, “SM”, “SP-SM”, and ”SC-SM” 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-54, B-56, B-58, B-63, B-69, B-72, B-77, B-81, B-84, B-86 through B-88, B-90, B-93 through B-95, and B-97 during drilling at a depth of 8 to 17 feet and then rose to a depth of 8 to 14 feet after drilling was complete. Groundwater at the site could be pressurized. Groundwater was not encountered in the remaining borings during drilling. Detailed groundwater levels encountered in the borings are summarized in Table 4.

Table 4. Groundwater Depths below Existing Ground Surface

Boring No.	Date Drilled	Boring Depth (ft)	Water Level (ft)	Cave-in Depth (ft)
B-47	6/30/14	13	Dry	n/a
B-48	6/30/14	17	Dry	n/a

AVLES
ENGINEERING CORP.

Boring No.	Date Drilled	Boring Depth (ft)	Water Level (ft)	Cave-in Depth (ft)
B-49	6/30/14	14	Dry	n/a
B-50	6/30/14	13	Dry	n/a
B-51	6/30/14	15	Dry	n/a
B-52	6/30/14	16	Dry	n/a
B-53	6/30/14	15	Dry	n/a
B-54	6/30/14	15	14 (Drilling) 14 (Complete)	n/a
B-55	6/30/14	14	Dry	n/a
B-56	7/7/14	15	14 (Drilling) 13 (Complete)	n/a
B-57	7/8/14	12	Dry	n/a
B-58	7/2/14	13	13 (Drilling) 13 (Complete)	n/a
B-59	7/2/14	13	Dry	n/a
B-60	7/2/14	13	Dry	n/a
B-61	7/2/14	14	Dry	n/a
B-62	7/2/14	13	Dry	n/a
B-63	7/2/14	16	14 (Drilling) 11.4 (Complete)	n/a
B-64	7/2/14	14	Dry	n/a
B-65	7/1/14	14	Dry	n/a
B-66	7/2/14	15	Dry	n/a
B-67	7/8/14	13	Dry	n/a
B-68	7/1/14	12	Dry	n/a
B-69	7/1/14	24	17 (Drilling) 10 (Complete)	n/a
B-70	7/8/14	12	Dry	n/a
B-71	7/8/14	13	Dry	n/a
B-72	7/7/14	24	14 (Drilling) 8 (Complete)	n/a
B-73	7/7/14	13	Dry	n/a
B-74	7/1/14	13	Dry	n/a
B-75	7/1/14	12	Dry	n/a
B-76	7/7/14	12	Dry	n/a
B-77	7/7/14	17	14 (Drilling) 10 (Complete)	n/a
B-78	7/8/14	13	Dry	n/a
B-79	7/7/14	13	Dry	n/a

AVLES
ENGINEERING CORP.

Boring No.	Date Drilled	Boring Depth (ft)	Water Level (ft)	Cave-in Depth (ft)
B-80	7/7/14	13	Dry	n/a
B-81	7/1/14	14	12 (Drilling) 12 (Complete)	n/a
B-82	7/7/14	18	Dry	n/a
B-83	6/27/14	15	Dry	n/a
B-84	6/27/14	15	15 (Drilling) 10 (Complete)	n/a
B-85	6/27/14	17	Dry	n/a
B-86	6/27/14	15	12 (Drilling) 12 (Complete)	n/a
B-87	6/27/14	13	10 (Drilling) 12.3 (Complete)	n/a
B-88	6/27/14	12	8 (Drilling) 11.4 (Complete)	n/a
B-89	7/8/14	13	Dry	n/a
B-90	7/1/14	15	15 (Drilling) 13 (Complete)	n/a
B-91	7/8/14	14	Dry	n/a
B-92	7/8/14	13	Dry	n/a
B-93	6/26/14	15	8 (Drilling) 12.5 (Complete)	n/a
B-94	6/27/14	14	12 (Drilling) 10.5 (Complete)	n/a
B-95	7/8/14	15	14 (Drilling) 12 (Complete)	n/a
B-96	7/8/14	14	Dry	n/a
B-97	7/1/14	17	16 (Drilling) 13 (Complete)	n/a
B-98	7/7/14	14	Dry	n/a
B-99	7/7/14	15	Dry	n/a

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 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 contain sand/silt seams/lenses/layers/pockets, as well as siltstones, ferrous nodules, and calcareous nodules. 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.

5.0 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Based on 90 percent complete drawings (dated April 9, 2015) provided to AEC by KCI Technologies, approximately 27,340 linear feet of existing 6 to 12 inch diameter waterlines will be replaced with new 8 to 12 inch waterlines. The proposed waterlines will be installed primarily by auger method. The maximum invert depths of the waterlines vary from 4.7 to 21.1 feet below grade.

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-5, 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.

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

$$W_e = C_d \gamma B_d^2 \quad \text{.....Equation (1)}$$

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

$$W_e = \gamma B_c H \quad \text{.....Equation (3)}$$

where:
- W_e = trench fill load, in pounds per linear foot (lb/ft);
- C_d = trench load coefficient, see Plate C-6, 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 H-20 or HS-20 truck) can be obtained from Plate C-7, in Appendix C. The live load on top of the underground conduit can be calculated from Equation (4):

$$W_L = p_L B_c \quad \text{.....Equation (4)}$$

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.

$$p_l = 0.5 (\gamma H_h + p_s) \quad \text{.....Equation (5)}$$

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-5, 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 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-54, B-59, B-63, B-69, B-72, B-77, midway between B-83 and B-84, B-85, B-86, and B-90. 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- 63, B-69, B-72, B-77, B-84, B-88, and B-93. 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 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: 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 Occupational Safety

and Health Administration (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-5, 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-5, 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, siltstones, 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 0.3 to 1.4 was estimated for the cohesive soils encountered within the auger zone of approximately 7 to 19 feet below existing grade for Borings B-47 through B-53, B-55 through B-58, B-60 through B-68, B-70, B-71, B-73 through B-76, B-78 through B-84, B-87 through B-89, and B-91 through B-99. N_t was not able to be determined due to the presence of granular soils within the auger zone of approximately 7 to 19 feet below existing grade for Borings B-54, B-59, B-69, B-72, B-77, B-85, B-86, and B-90. 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 10 to 25 feet (depending on invert depths ranging from 7 to 19 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.

5.3 Select Fill

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

AVLES
ENGINEERING CORP.

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.

AVLES
ENGINEERING CORP.

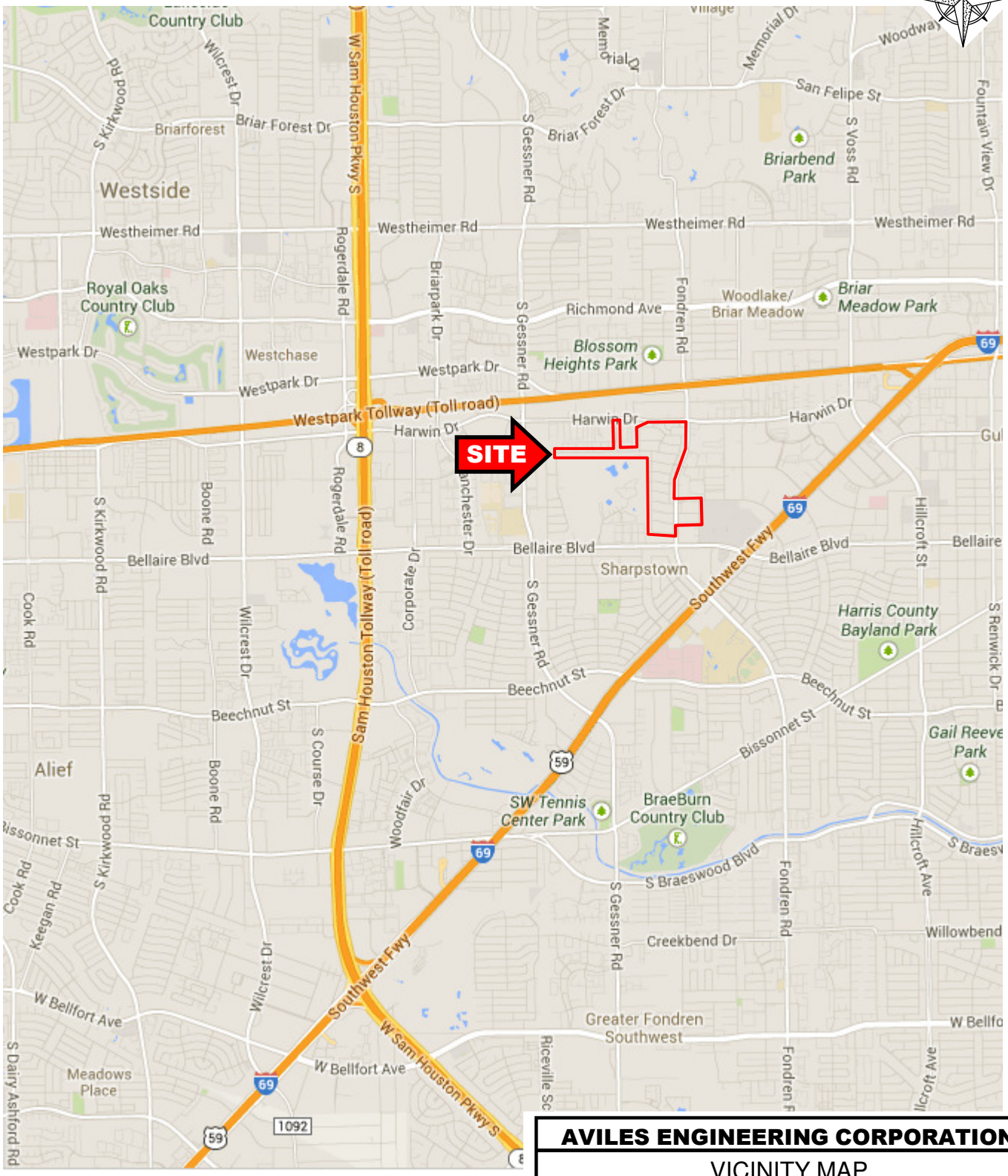
7.0 LIMITATIONS

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



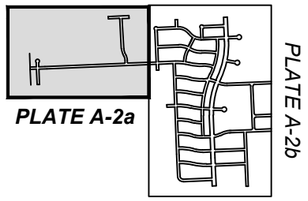
AVILES ENGINEERING CORPORATION

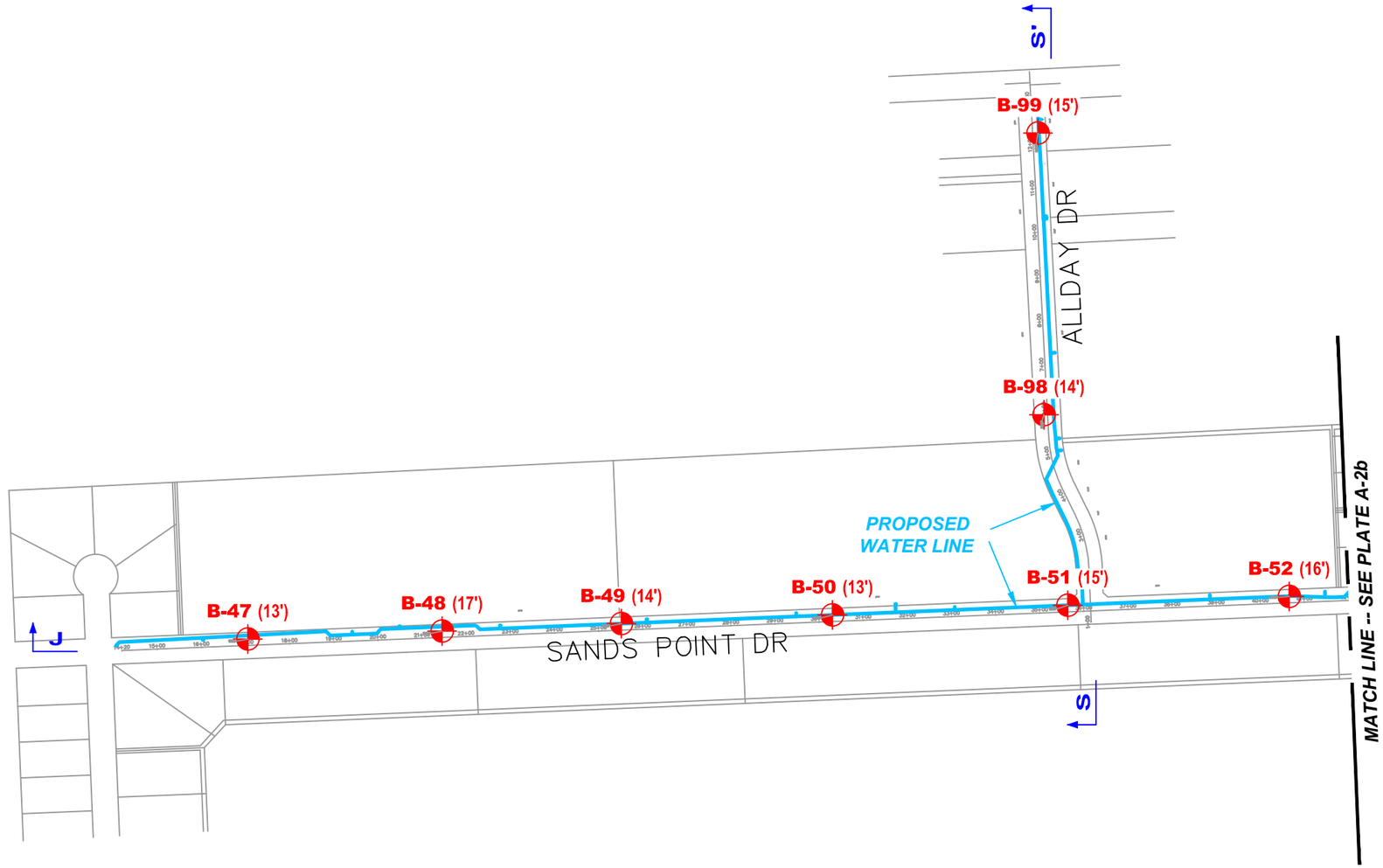
VICINITY MAP

WATERLINE REPLACEMENT IN
SHARPSTOWN COUNTRY CLUB ESTATES AREA
WBS No. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING BY:
G110-13	09-30-14	GOOGLE MAPS
APPROX. SCALE:	DRAFTED BY:	PLATE NO.:
N.T.S.	WIW	PLATE A-1

AREA KEY MAP





REFERENCE DRAWINGS

STREET NAME	*PROFILE*	*PLATE NO.*
ALLDAY	S-S'	B-17
BELLERIVE	H-H'	B-8
CLAREWOOD	D-D'	B-4
DASHWOOD	B-B'	B-2
DE MOSS	C-C'	B-3
GULFTON	K-K'	B-10
HIAWATHA	A-A'	B-1
HIGH STAR	G-G'	B-7
HORNWOOD	E-E'	B-5
LUGARY	N-N'	B-13
MARINETTE	M-M'	B-12
MOONMIST	F-F'	B-6
OSAGE	R-R'	B-16
PRESTWOOD	L-L'	B-11
SANDS POINT	J-J'	B-9a, B-9b
TAM O SHANTER (s)	P-P'	B-14a, B-14b
TAM O SHANTER (n)	Q-Q'	B-15

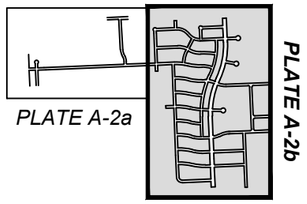
AVILES ENGINEERING CORPORATION

BORING LOCATION PLAN

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	KCI
SCALE :	DRAFTED BY :	PLATE NO. :
1" = 300'	BpJ	PLATE A-2a

AREA KEY MAP



MATCH LINE -- SEE PLATE A-2a

REFERENCE DRAWINGS

STREET NAME	PROFILE	PLATE NO.	STREET NAME	PROFILE	PLATE NO.
ALLDAY	S-S'	B-17			
BELLERIVE	H-H'	B-8	LUGARY	N-N'	B-13
CLAREWOOD	D-D'	B-4	MARINETTE	M-M'	B-12
DASHWOOD	B-B'	B-2	MOONMIST	F-F'	B-6
DE MOSS	C-C'	B-3	OSAGE	R-R'	B-16
GULFTON	K-K'	B-10	PRESTWOOD	L-L'	B-11
HIAWATHA	A-A'	B-1	SANDS POINT	J-J'	B-9a, B-9b
HIGH STAR	G-G'	B-7	TAM O SHANTER (s)	P-P'	B-14a, B-14b
HORNWOOD	E-E'	B-5	TAM O SHANTER (n)	Q-Q'	B-15

AVILES ENGINEERING CORPORATION

BORING LOCATION PLAN

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	KCI
SCALE :	DRAFTED BY :	PLATE NO. :
1" = 300'	BpJ	PLATE A-2b

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-47**

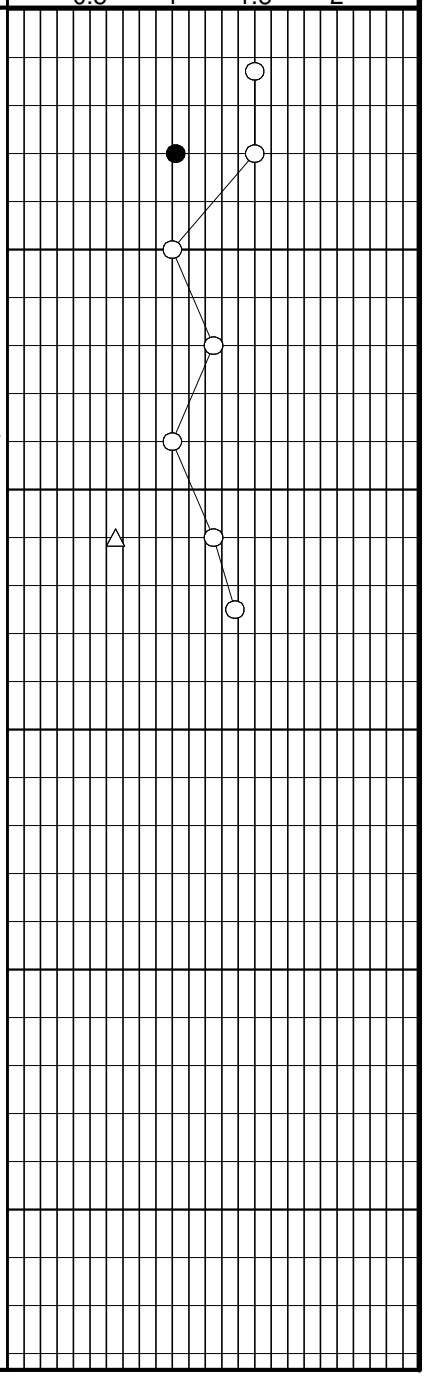
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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: 3068864.62* *Northing: 13825239.50* *Elevation: 67.69*							
	0			Pavement: 6.875" concrete							
				Very stiff, gray and tan Lean Clay w/Sand (CL), with siltstone fragments, calcareous and ferrous nodules		71		20	45	14	31
64	4						108	19			
				Stiff to very stiff, tan and light gray Sandy Lean Clay (CL), with ferrous nodules -with siltstone fragments and calcareous nodules 4'-8'				16			
								21			
60	8					60		16	31	14	17
				-with siltstone fragments and calcareous nodules 10'-13'			120	15			
56	12							16			
				Termination depth = 13 feet							
52	16										
48	20										
44	24										
40	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13 **PLATE A-3**

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-48**

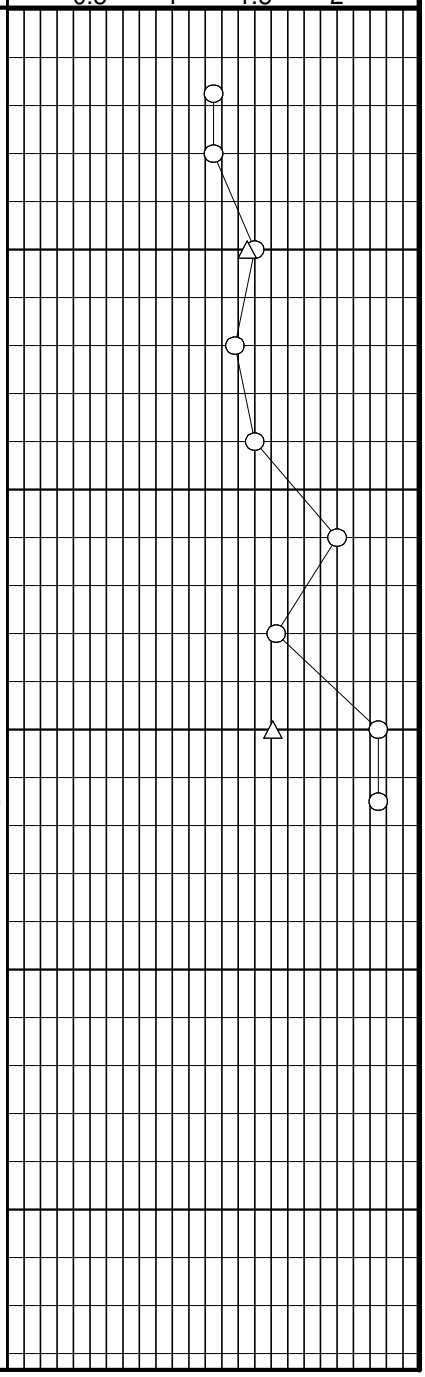
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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							
		Base: 8" stabilized dark gray clayey sand							
64		Very stiff, dark gray Lean Clay w/Sand (CL), with siltstone fragments and ferrous nodules		80		19	47	14	33
	4	-with fat clay pockets 2'-4'				19			
		-gray and tan, with calcareous nodules 4'-6'			110	20			
60		Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules				18			
	8	-with siltstone fragments 6'-8'		69		16	33	12	21
56						16			
	12	-with siltstone fragments 12'-14'				16			
52					118	15			
	16			68		15	32	13	19
		Termination depth = 17 feet							
48									
	20								
44									
	24								
40									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **n/a** FEET WHILE DRILLING ▽
WATER LEVEL AT **n/a** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-4

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-49**

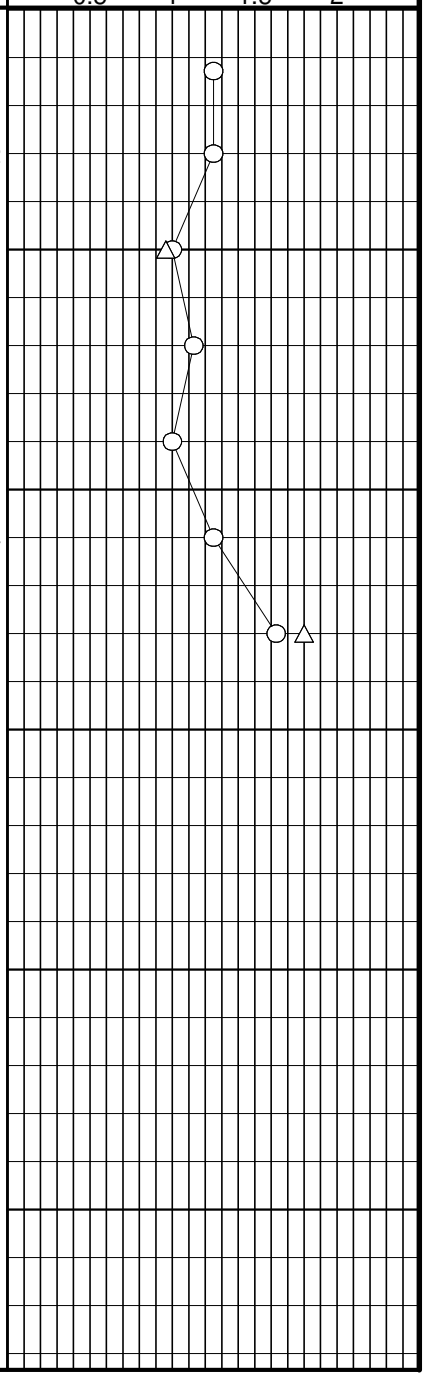
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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: 6.75" concrete							
64				Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules				28			
						83		23	59	17	42
	4						103	23			
60				-tan and gray, with calcareous nodules 6'-8'				24			
	8			Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules -with silt pockets and calcareous nodules 8'- 10'				23			
56						73		18	36	12	24
	12						115	18			
52				Termination depth = 14 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-5

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-50**

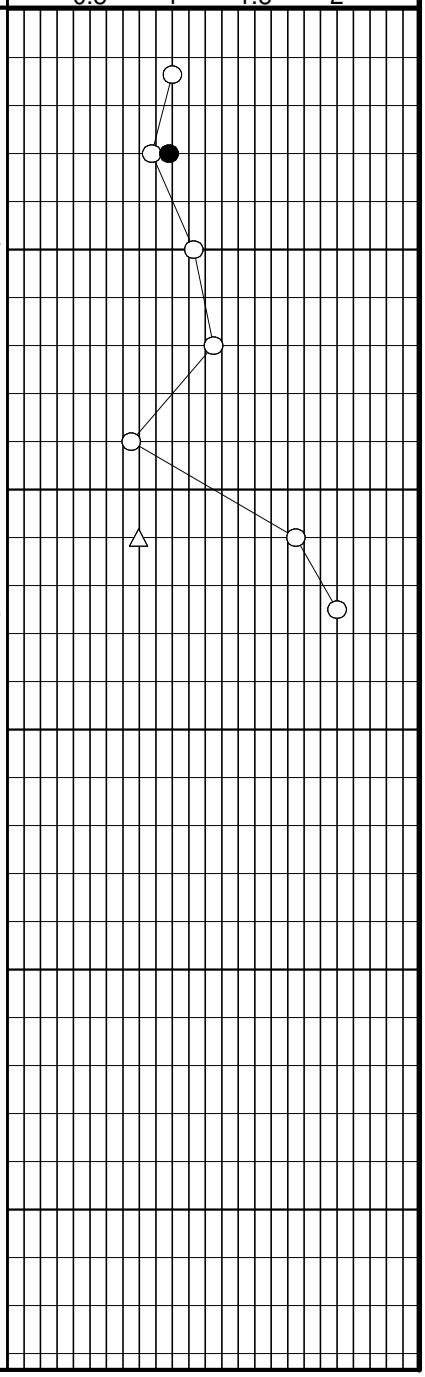
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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							
		Base: 2" stabilized clayey sand							
		Stiff to very stiff, dark gray Fat Clay (CH)				22			
64		-with sandy clay seams 0'-2'							
		-with ferrous nodules 2'-10'			101	24			
	4	-with siltstone fragments 4'-8'							
				89		26	65	18	47
60		-gray and tan 6'-10'							
						26			
	8	-with sandy clay pockets 8'-10'							
						26			
56		Stiff to very stiff, light gray and tan Lean Clay w/Sand (CL)							
					98	33			
	12	-with silt partings 10'-12'							
		-with ferrous nodules 12'-14'		73		15	39	14	25
		Termination depth = 13 feet							
52									
	16								
48									
	20								
44									
	24								
40									
	28								

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-6

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-51**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

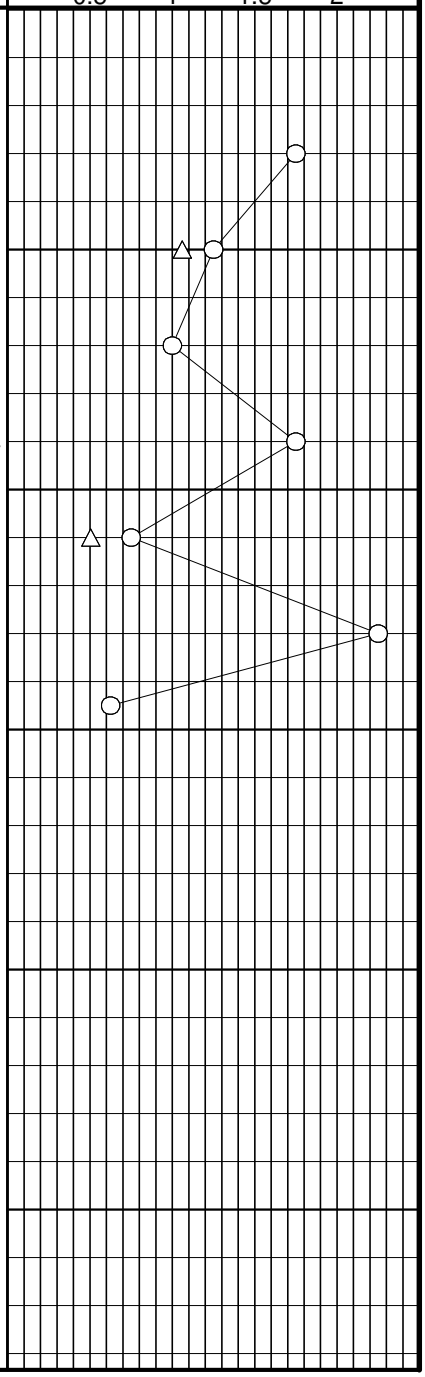
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
		Base: 11" stabilized clayey sand							
64		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules		78		23	58	17	41
	4				99	26			
60		-tan and light gray, with siltstone fragments and calcareous nodules 6'-8'				25			
	8	Stiff to hard, tan and light gray Sandy Lean Clay (CL), with slickensides and ferrous nodules		65		16	37	13	24
56		-with siltstone fragments and calcareous nodules 8'-12'			105	17			
	12					15			
52		Light gray and tan, Silty Clayey Sand (SC-SM), with silt partings		31		19	26	20	6
	16	Termination depth = 15 feet							
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3070721.48
Northing: 13825316.08
Elevation: 65.65

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-7

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-52**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

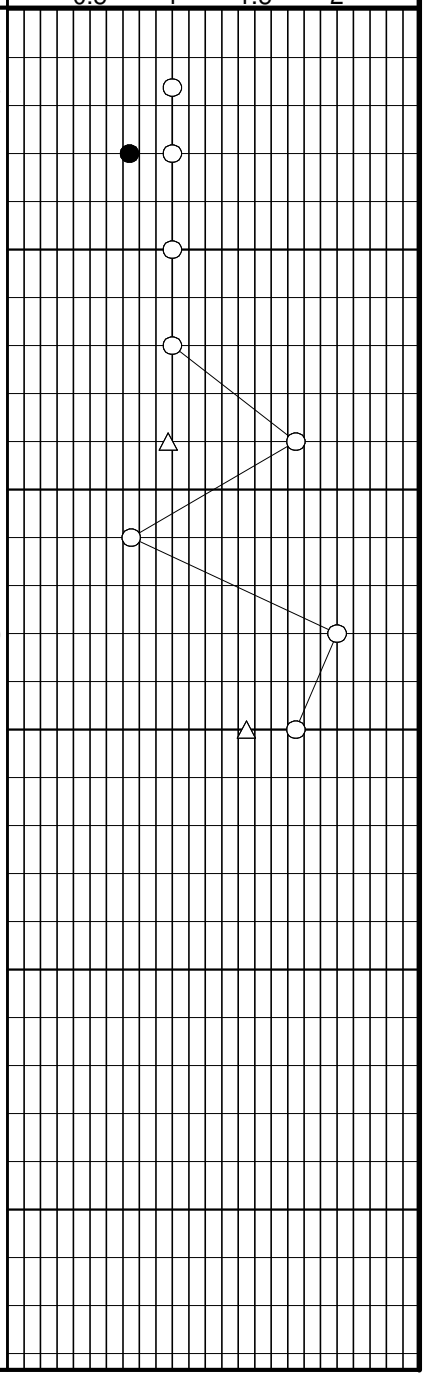
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7.25" concrete							
		Base: 7.75" stabilized clayey sand							
64		Stiff, dark gray Fat Clay (CH), with ferrous nodules		88		25	63	20	43
	4				98	24			
						26			
60		-gray and tan, with siltstone fragments 6'-8'							
				86		25	58	17	41
	8	Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules			113	16			
56		-with siltstone fragments 8'-12'							
						21			
	12	-with calcareous nodules 12'-14'							
				66		15	33	14	19
52					115	16			
	16	Termination depth = 16 feet							
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3071223.02
Northing: 13825335.90
Elevation: 65.68

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-8

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-53**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

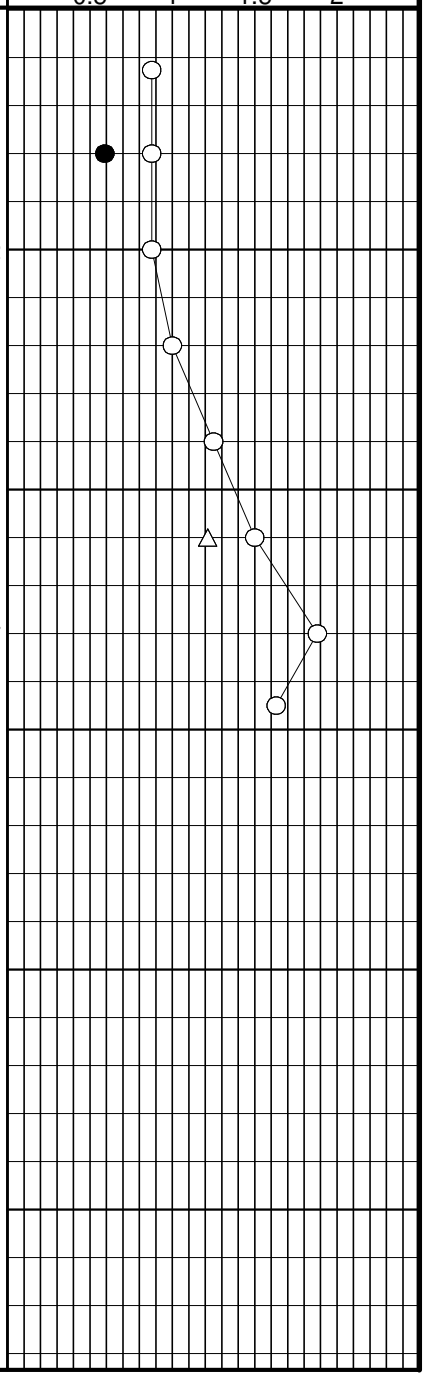
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.25" concrete							
64		Stiff, dark gray Fat Clay (CH)				22			
		-with ferrous nodules 2'-8'			100	26			
	4	-with calcareous nodules 4'-8'							
60				86		27	61	19	42
		-with siltstone fragments 6'-8'				30			
	8	Very stiff, light gray and tan Sandy Lean Clay (CL)				18			
56		-with silt partings 10'-12'			116	17			
	12	-with ferrous nodules 12'-14'							
52				65		14	40	13	27
						18			
	16	Termination depth = 15 feet							
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3071733.80
Northing: 13825350.32
Elevation: 65.33

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-9

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-54**

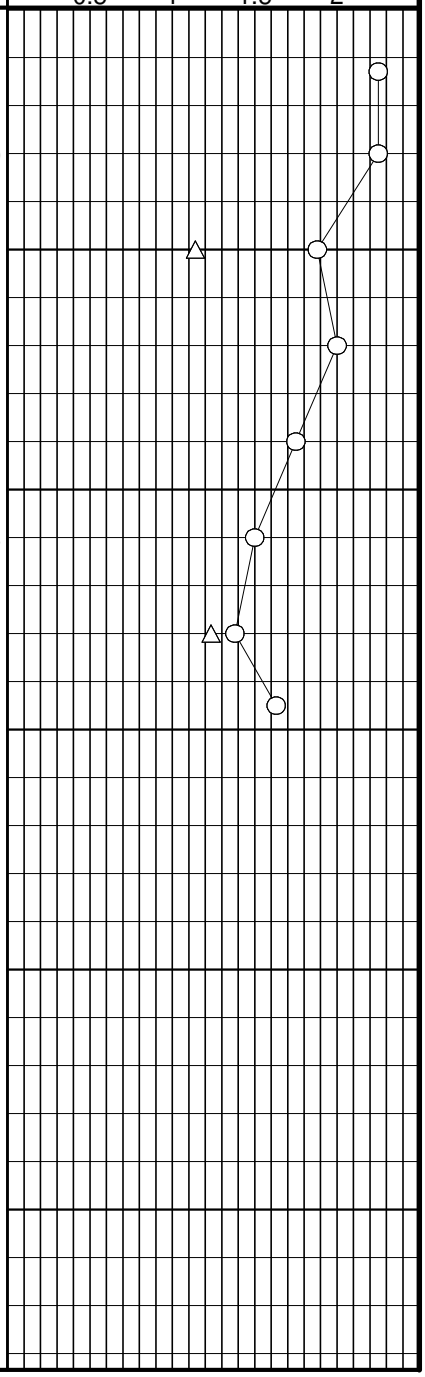
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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							
				Very stiff to hard, gray and tan Fat Clay w/ Sand (CH), with calcareous and ferrous nodules				19			
				-with roots 0'-2'		77		18	56	16	40
60	4			-with siltstone fragments 2'-6'							
				-tan and red 4'-6'			111	20			
				Very stiff to hard, tan and light gray Sandy Lean Clay (CL)				15			
56	8			-with siltstone fragments and calcareous nodules 6'-8'							
				-with ferrous nodules 8'-10'				15			
				Tan and light gray Clayey Sand (SC), with abundant silt partings		38		16	28	15	13
52	12						117	15			
								18			
				Termination depth = 15 feet							
48	16										
44	20										
40	24										
36	28										

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 **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **14** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-10

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-55**

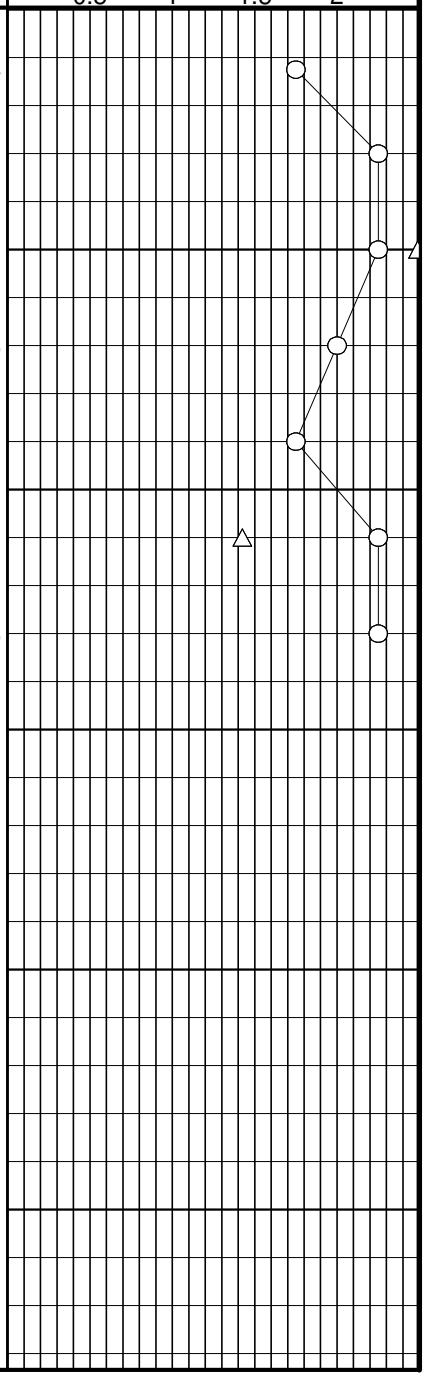
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/30/2014**

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							
64				Very stiff to hard, tan and gray Lean Clay w/ Sand (CL), with siltstone fragments and calcareous nodules -with ferrous nodules 0'-2'		73		17	48	14	34
	4							14			
60							119	12			
				Very stiff to hard, light gray and tan Sandy Lean Clay (CL) -with abundant siltstone fragments and calcareous nodules 6'-8' -light gray, tan, and red, with ferrous nodules 8'-11'		52		16	39	14	25
	8										
56								16			
				Tan and light gray, Clayey Sand (SC), with ferrous nodules			120	15			
	12										
52						44		13	31	16	15
				Termination depth = 14 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-11

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-56**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

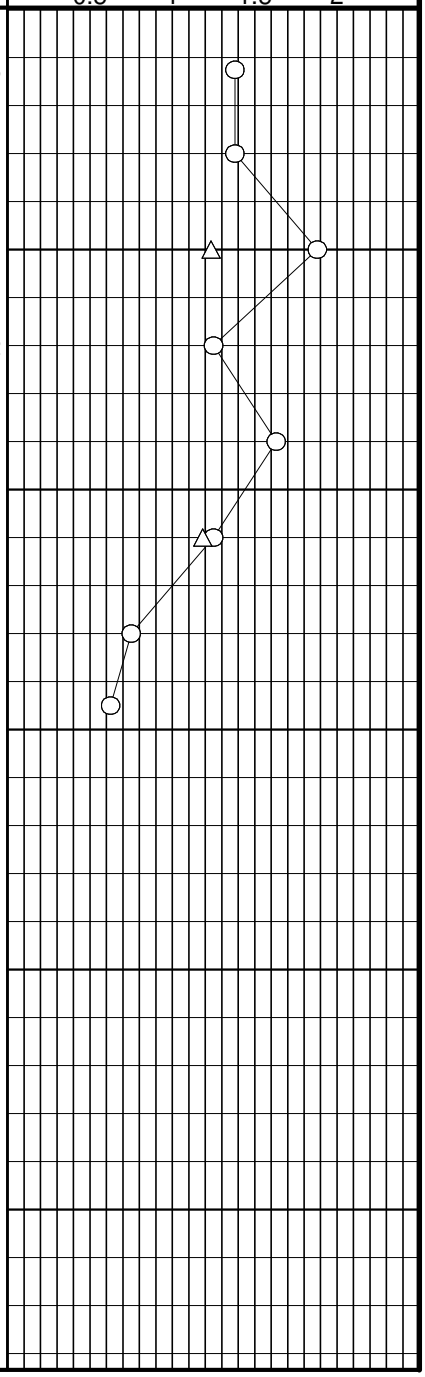
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
64	0			Pavement: 6.125" concrete							
				Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules		68		15	39	14	25
				-with siltstone fragments and calcareous nodules 0'-6'				18			
60	4						115	17			
				-light gray, tan, and red 6'-14', with calcareous nodules 6'-8'		65		16	34	12	22
56	8							16			
							115	18			
52	12			-with silt partings 12'-14'							
								17			
				Light gray and tan, Silty Clayey Sand (SC-SM), with sand and silt partings, wet		24		18	24	20	4
48	16			Termination depth = 15 feet							
44	20										
40	24										
36	28										

Survey Coordinates (TSPC, Surface):
Easting: 3073029.51
Northing: 13825436.41
Elevation: 64.03

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 **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **13** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-12

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-57**

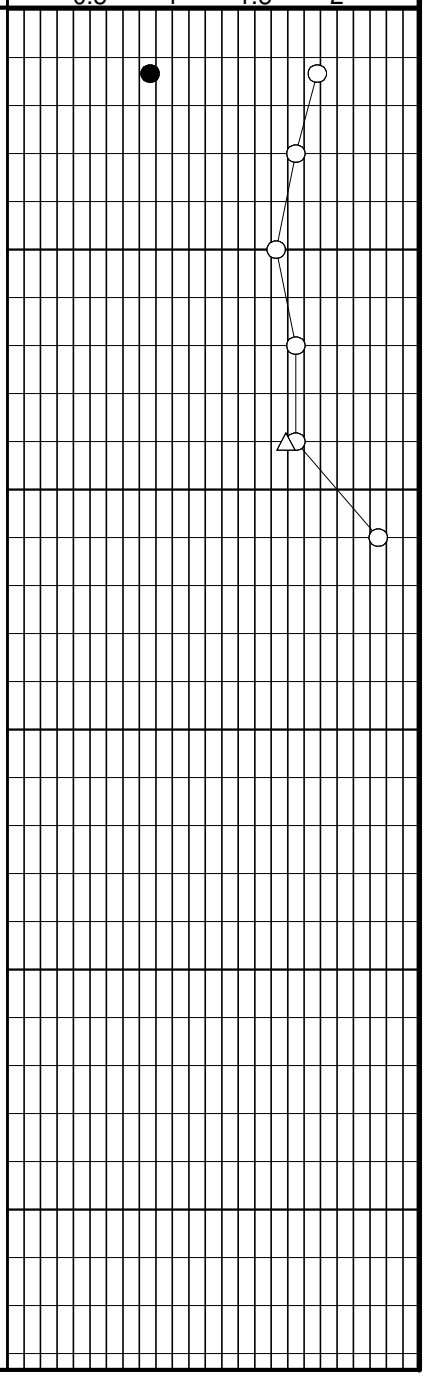
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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: 3073373.32							
				Northing: 13825367.47							
				Elevation: 63.58							
60	0			Pavement: 1" asphalt							
				Pavement: 7" concrete			119	13			
				Stiff to hard, tan and light gray Lean Clay w/ Sand (CL)				16			
	4			-with siltstone fragments and calcareous nodules 0'-4'							
				-with ferrous nodules 2'-12'		78		19	49	16	33
								15			
56	8			-tan, light gray, and red 8'-12'			119	15			
								14			
52	12			Termination depth = 12 feet							
48	16										
44	20										
40	24										
36	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-13

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-58**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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
64	0			*Survey Coordinates (TSPC, Surface):* *Easting: 3072932.90* *Northing: 13825619.16* *Elevation: 64.15* . Pavement: 6.25" concrete							
				Stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules -with siltstone fragments and calcareous nodules 0'-8'			113	16			
								17			
60	4					51		16	46	14	32
								20			
56	8							16			
				-tan, light gray, and red, with silt pockets 10'-12'			119	15			
52	12			Tan, light gray, and red Clayey Sand (SC), with ferrous nodules		43		13	31	14	17
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
36	28										

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 **13** FEET WHILE DRILLING ▽
WATER LEVEL AT **13** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-14

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-59**

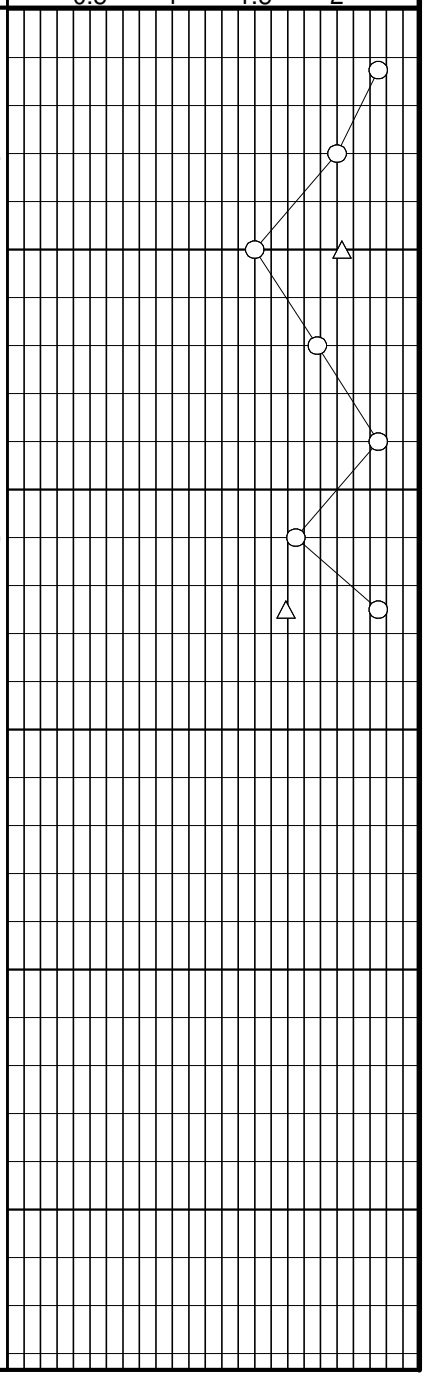
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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: 6.25" concrete							
				Very stiff to hard, gray Fat Clay (CH), with siltstone fragments and ferrous nodules				20			
				-dark gray 2'-6'		89		19	65	17	48
60	4			-with calcareous nodules 4'-6'			109	21			
								18			
56	8			Tan and light gray Clayey Sand (SC)				15			
				-with abundant silt partings 10'-12'		45		13	31	12	19
52	12						121	12			
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
36	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-15

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-60**

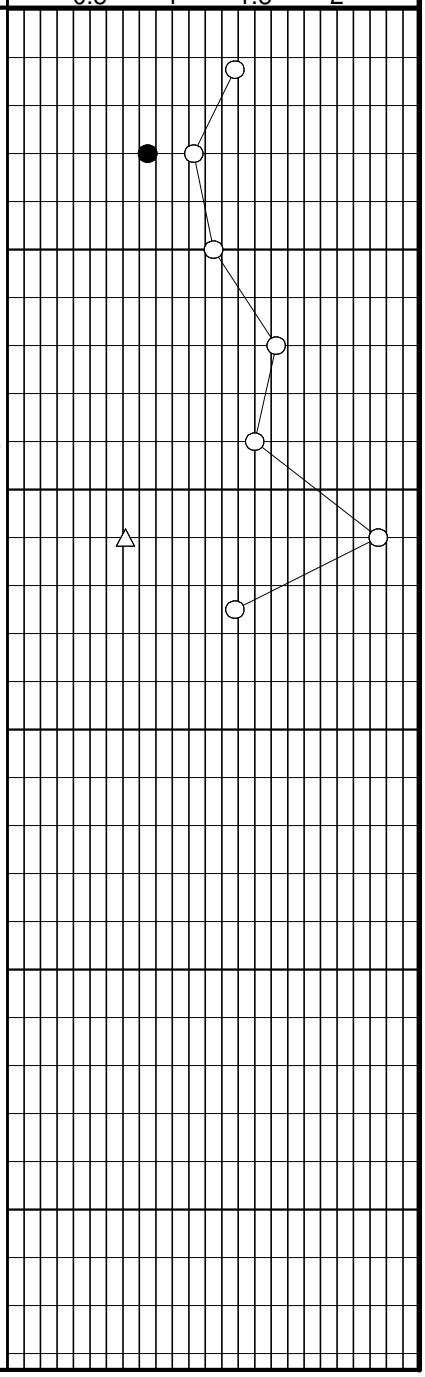
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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							
64				Stiff to very stiff, gray Fat Clay w/Sand (CH), with ferrous nodules		76		22	57	16	41
							103	23			
	4			-tan and light gray, with siltstone fragments and calcareous nodules 4'-6'				25			
60											
				Stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules				15			
	8										
56						53		16	29	13	16
							118	16			
	12							17			
52				Termination depth = 13 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-16

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-61**

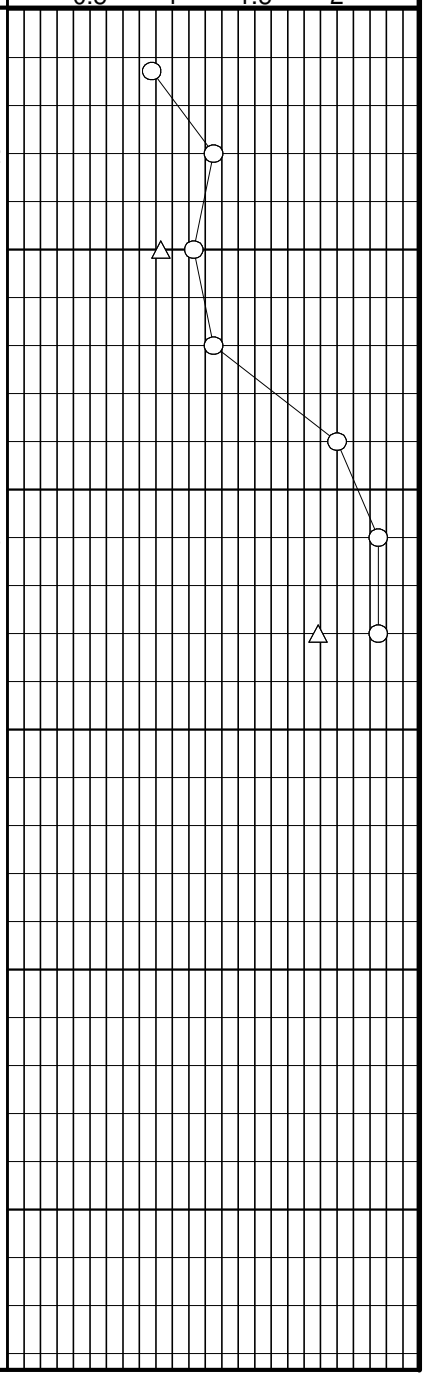
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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
64	0	Pavement: 6.75" concrete							
		Stiff to very stiff, dark gray Fat Clay (CH), with slickensides and ferrous nodules				24			
		-tan and light gray 2'-8'		85		23	60	18	42
60	4	-with calcareous nodules 4'-8'			104	22			
		-with siltstone fragments 6'-8'				25			
56	8	Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules				15			
				69		13	35	12	23
52	12				114	19			
		Termination depth = 14 feet							
48	16								
44	20								
40	24								
	28								

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-17

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-62**

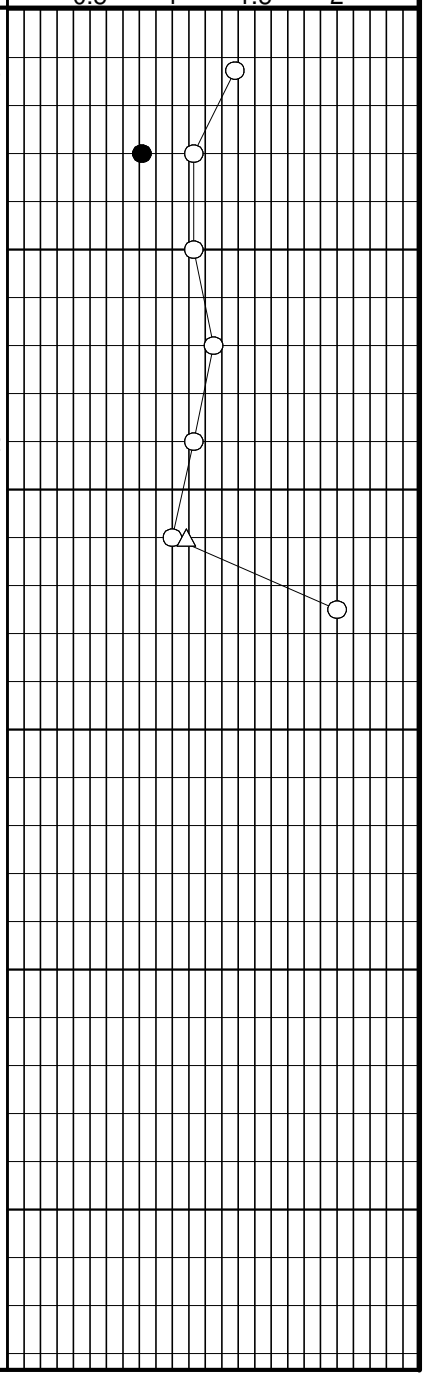
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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							
64		Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with ferrous nodules		76		20	49	16	33
		-with silt partings 2'-4'			96	27			
	4								
60		-gray and tan, with siltstone fragments and calcareous nodules 4'-8'				24			
						21			
	8								
56		Very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules		62		17	34	12	22
					117	17			
	12								
52						16			
		Termination depth = 13 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3071514.54
Northing: 13826154.86
Elevation: 65.46

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-18

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-63**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

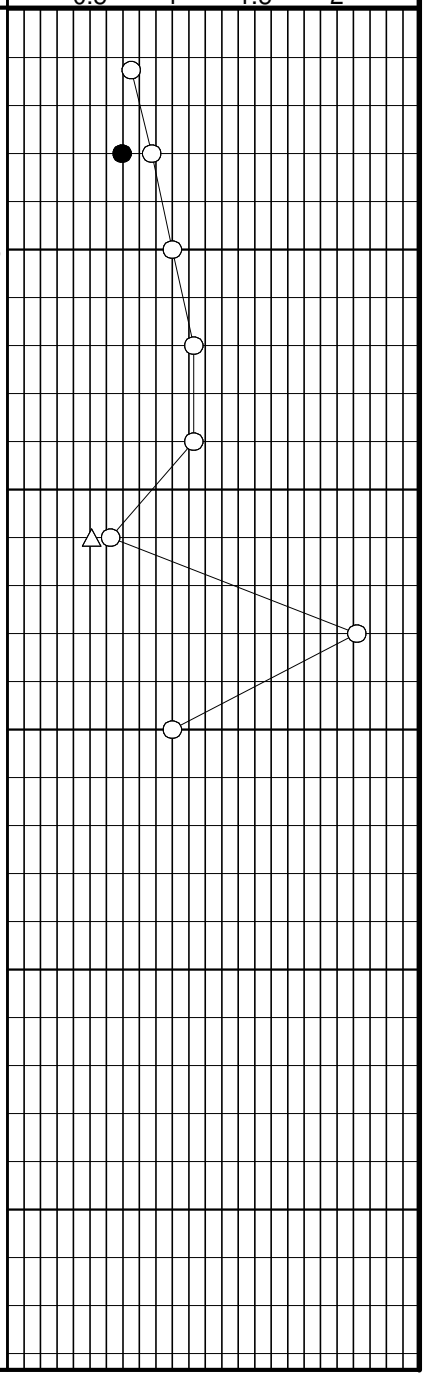
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
64	0	Pavement: 6.25" concrete							
		Stiff to very stiff, gray Fat Clay w/Sand (CH), with ferrous nodules				27			
					102	23			
	4	-gray and tan 4'-8'							
60				82		27	62	17	45
		-with calcareous nodules 6'-8'				26			
	8	Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules				20			
56					105	24			
	12	Light gray and tan Clayey Sand (SC)							
52		-with ferrous nodules 12'-14'		26		15	26	18	8
		-with silt partings 14'-16', wet at 14'				16			
	16	Termination depth = 16 feet							
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072107.17
Northing: 13826235.73
Elevation: 64.73

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 **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **11.4** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-19

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-64**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

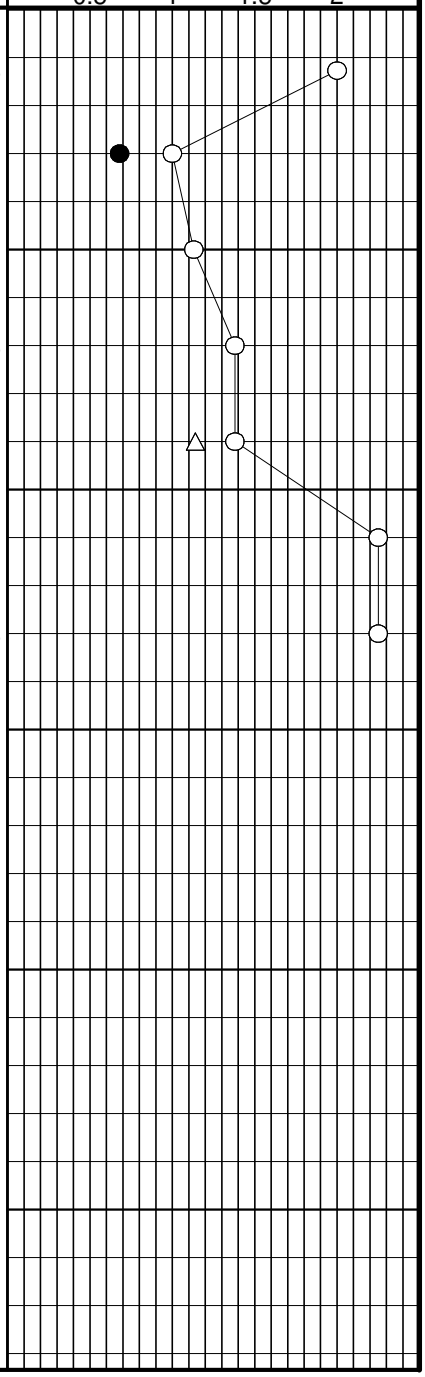
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.5" concrete							
64		Very stiff, dark gray Lean Clay w/Sand (CL), with slickensides and ferrous nodules		77		19	48	15	33
		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with slickensides and ferrous nodules			101	25			
	4								
60						25			
		-gray and tan, with siltstone fragments 6'-8'		83		23	62	19	43
	8								
56		Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules			115	18			
		-light gray, tan, and red 10'-14'							
						14			
	12								
52				54		15	36	13	23
		Termination depth = 14 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072459.70
Northing: 13826014.00
Elevation: 64.92

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-20

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-65**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

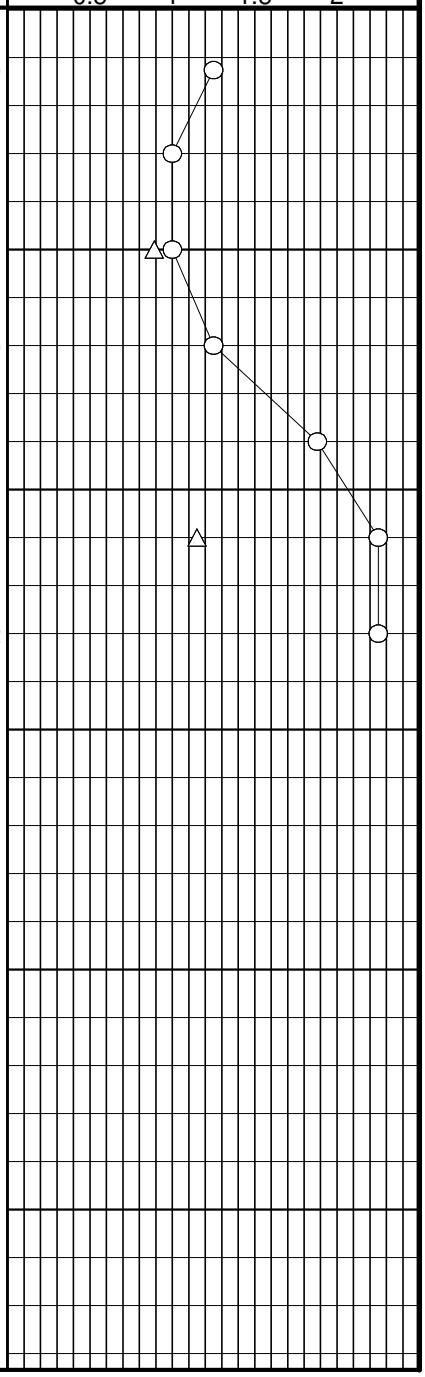
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.25" concrete							
64		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules		78		22	56	16	40
						23			
	4	-gray 4'-6'							
60					99	26			
		-gray and tan, with siltstone fragments and calcareous nodules 6'-8'		75		23	58	18	40
	8	Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules				18			
56					119	15			
	12								
52				62		16	36	14	22
		Termination depth = 14 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072691.17
Northing: 13826055.38
Elevation: 64.69

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-21

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-66**

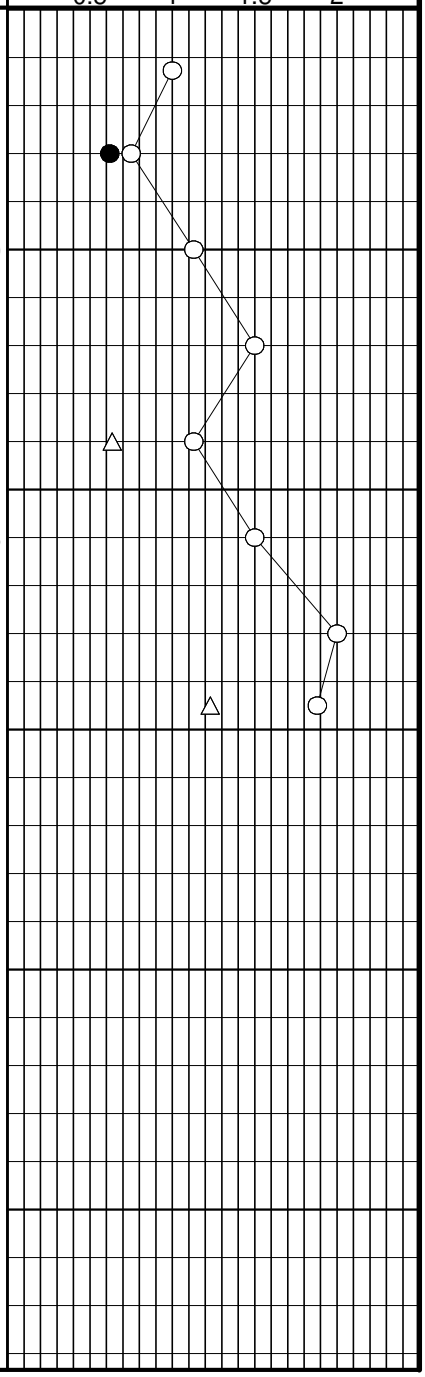
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/2/2014**

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
64	0	Pavement: 6.5" concrete							
		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules				20			
		-gray 2'-6'			99	25			
	4	-with siltstone fragments 4'-8'							
60				81		21	56	17	39
		-tan and gray, with calcareous nodules 6'-8'				20			
	8	Stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules			101	24			
56		-with silt partings 8'-12'							
				63		16	29	13	16
	12								
52						15			
					114	17			
		Termination depth = 15 feet							
48	16								
44	20								
40	24								
	28								

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-22

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-67**

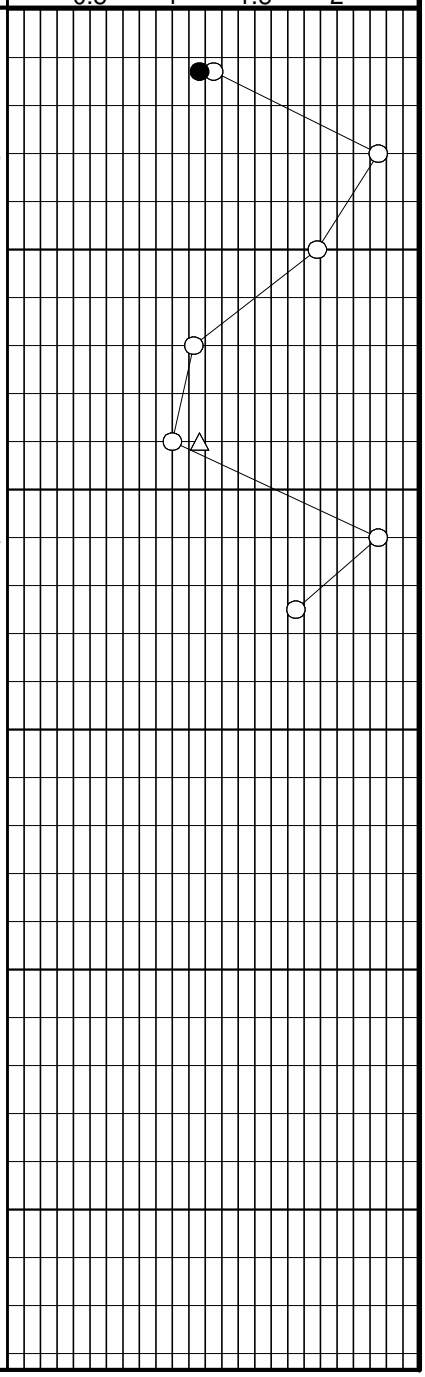
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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
64	0			Pavement: 7" concrete							
				Very stiff to hard, gray and light gray Sandy Fat Clay (CH), with slickensides, abundant calcareous and ferrous nodules, and siltstone fragments			108	21			
				-light gray and tan 2'-6'		64		17	51	16	35
60	4							22			
				Very stiff to hard, tan, light gray, and red Sandy Lean Clay (CL), with ferrous nodules				17			
56	8			-with calcareous nodules and siltstone fragments 6'-8'							
				-with silt partings 8'-10'			113	17			
						64		14	38	14	24
52	12							15			
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
36	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-23

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-68**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

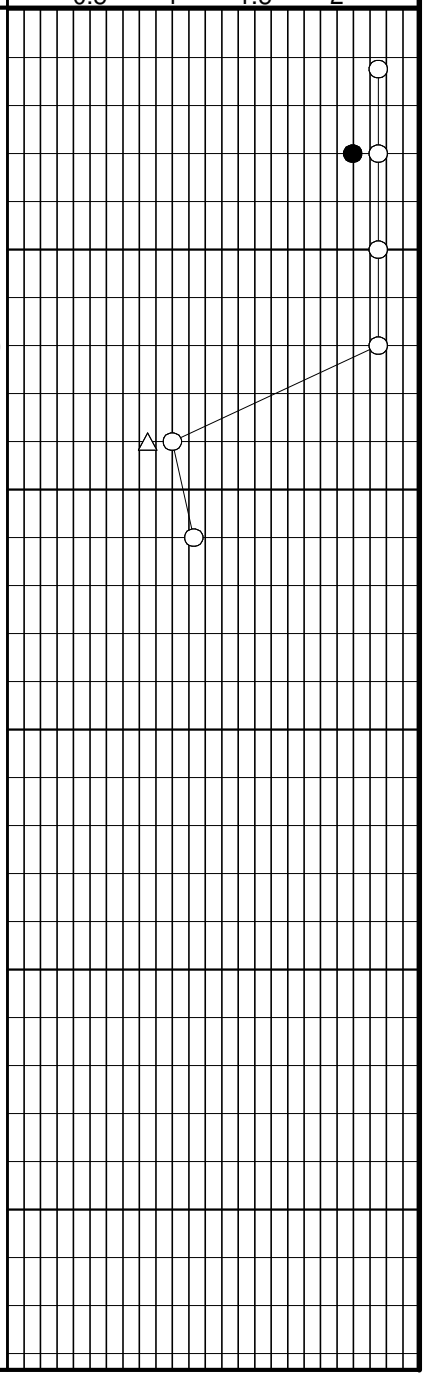
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
64	0	Pavement: 5.75" concrete							
		Stiff to hard, dark gray Fat Clay w/Sand (CH), with slickensides and ferrous nodules				18			
					110	15			
60	4	-gray and tan 4'-12'				18			
				85		19	68	19	49
56	8	-with sand partings 8'-12'			102	25			
						23			
52	12	Termination depth = 12 feet							
48	16								
44	20								
40	24								
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072900.03
Northing: 13826253.97
Elevation: 64.54

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-24

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-69**

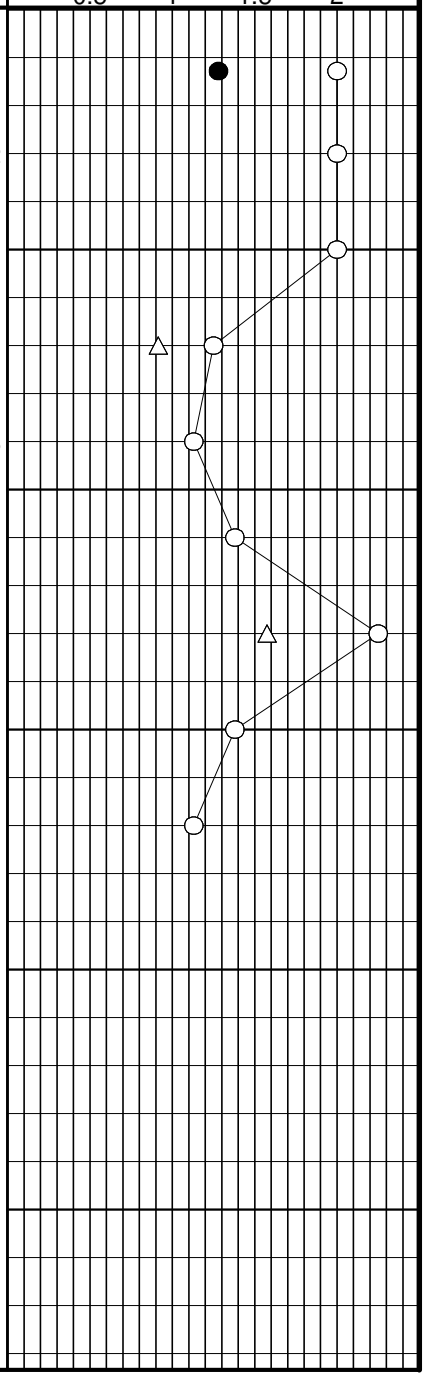
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

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
		Survey Coordinates (TSPC, Surface): *Easting: 3071975.74* *Northing: 13825293.61* *Elevation: 64.84*							
64	0	Pavement: 6.75" concrete							
		Stiff to hard, dark gray Fat Clay w/Sand (CH), with ferrous nodules			107	19			
				81		19	59	17	42
	4								
60						21			
		-tan and light gray, with sand pockets 6'-8'			108	20			
	8								
56		Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules		63		16	29	11	18
		-wet at 10'							
						15			
	12								
52					121	14			
		Light gray and tan Silty Clayey Sand (SC-SM)		44		16	23	16	7
	16								
48		-wet at 17'				17			
		Medium dense, light gray and tan Poorly Graded Sand w/Silt (SP-SM), wet	17			20			
	20								
44		-light gray 22'-24'	22	5		23			
	24								
40		Termination depth = 24 feet							
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **24** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **17** FEET WHILE DRILLING ▽
WATER LEVEL AT **10** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-25

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-70**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

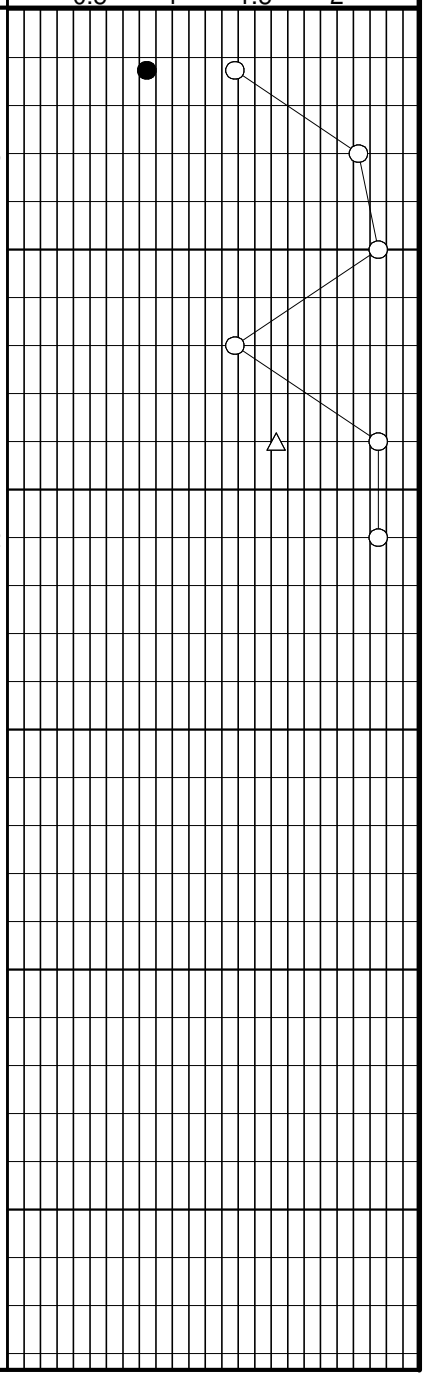
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6.375" concrete							
				Stiff to hard, tan and light gray Lean Clay w/ Sand (CL), with calcareous and ferrous nodules, and siltstone fragments			107	21			
						74		15	49	14	35
60	4							18			
								18			
56	8			Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules			117	16			
						58		14	34	12	22
52	12			Termination depth = 12 feet							
48	16										
44	20										
40	24										
36	28										

Survey Coordinates (TSPC, Surface):
Easting: 3072093.45
Northing: 13824986.35
Elevation: 63.95

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-26

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-71**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

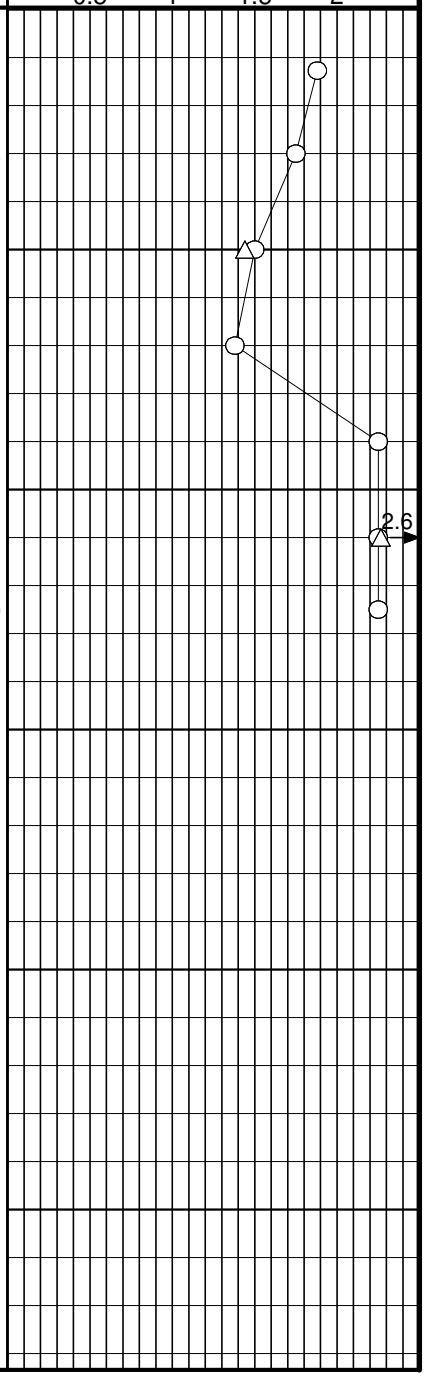
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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							
				Very stiff to hard, light gray and tan Lean Clay w/Sand (CL), with ferrous nodules				16			
				-with abundant calcareous nodules and siltstone fragments 0'-8'		71		17	48	15	33
60	4						110	19			
				-red, brown, tan, and light gray 6'-8'				19			
56	8			-light gray, tan, and red 8'-10'				14			
							127	13			
52	12			Light gray and tan Clayey Sand (SC), with sand pockets		37		14	31	12	19
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
36	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-27

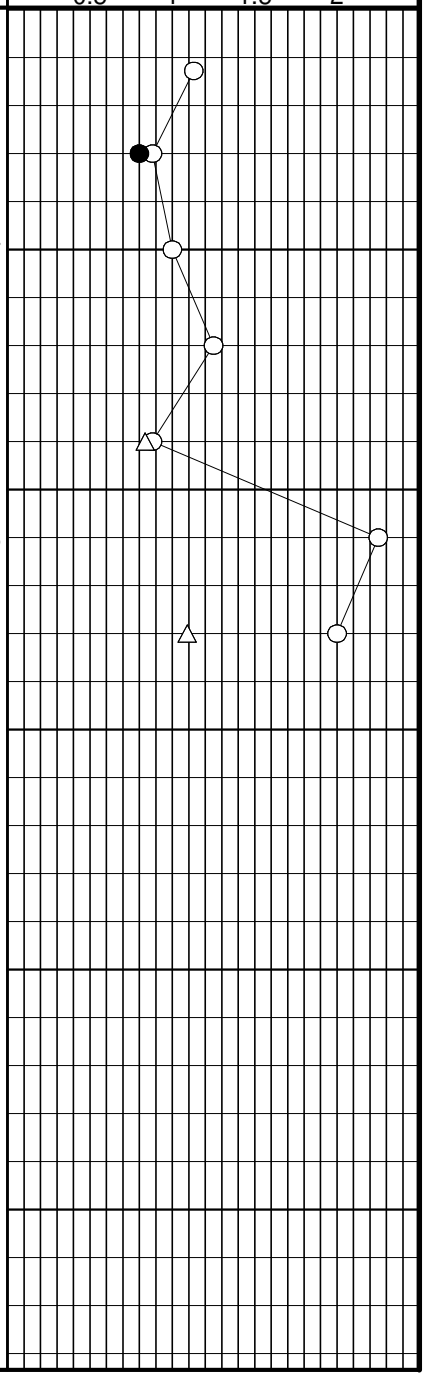
PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-72**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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
		Survey Coordinates (TSPC, Surface):							
		Easting: 3072817.23							
		Northing: 13824863.08							
		Elevation: 63.56							
60	0	Pavement: 6.625" concrete							
		Stiff to very stiff, gray Sandy Lean Clay (CL)				23			
		-with silt pockets and ferrous nodules 0'-2'							
		-with abundant calcareous nodules and siltstone fragments 2'-6'			108	21			
	4	-tan and light gray 4'-6'		57		14	43	16	27
		-light gray, tan, and red, with ferrous nodules 6'-10'				24			
56	8				116	15			
		Tan, light gray, and red Clayey Sand (SC), with ferrous nodules		46		12	29	13	16
52	12				118	15			
		-wet at 14'							
48	16					19			
		Medium dense, tan and light gray Poorly Graded Sand w/Silt (SP-SM), wet		10		20			
44	20		29			20			
40	24	Very stiff, light gray and tan Sandy Lean Clay (CL), with sand seams	24			20			
		Termination depth = 24 feet							
36	28								



BORING DRILLED TO **24** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **14** FEET WHILE DRILLING

WATER LEVEL AT **8** FEET AFTER **COMPLETE**

DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-28

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-73**

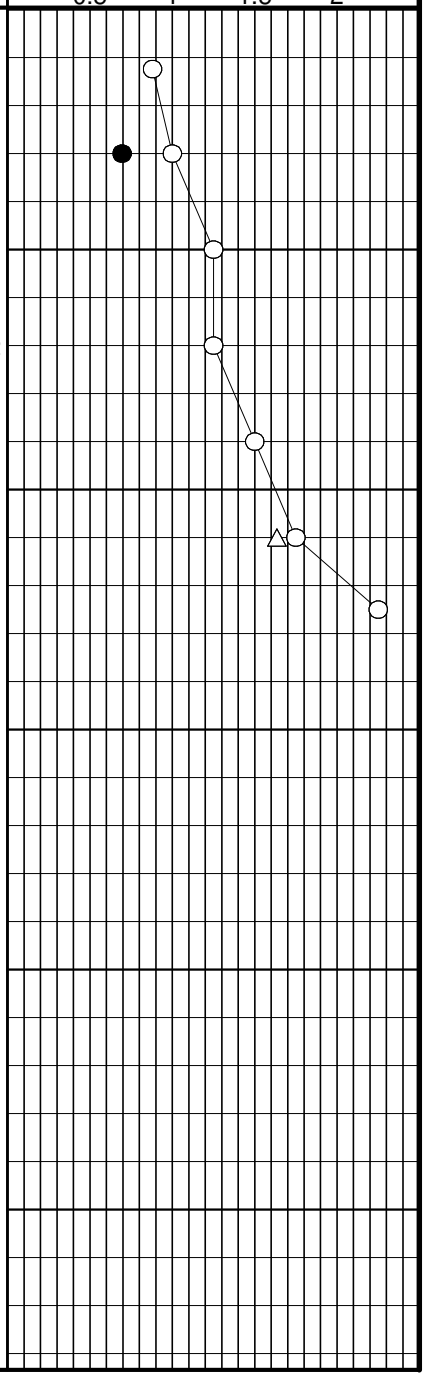
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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
64	0			Pavement: 5.75" concrete							
				Stiff, dark gray Fat Clay (CH)				22			
				Stiff to hard, tan and light gray Lean Clay (CL), with sand partings and ferrous nodules			108	19			
60	4							19			
				-light gray, tan, and red, with calcareous nodules and siltstone fragments 6'-8'		86		20	48	16	32
56	8							15			
				-light gray, tan, and red 10'-12'			119	15			
52	12							14			
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-29

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-74**

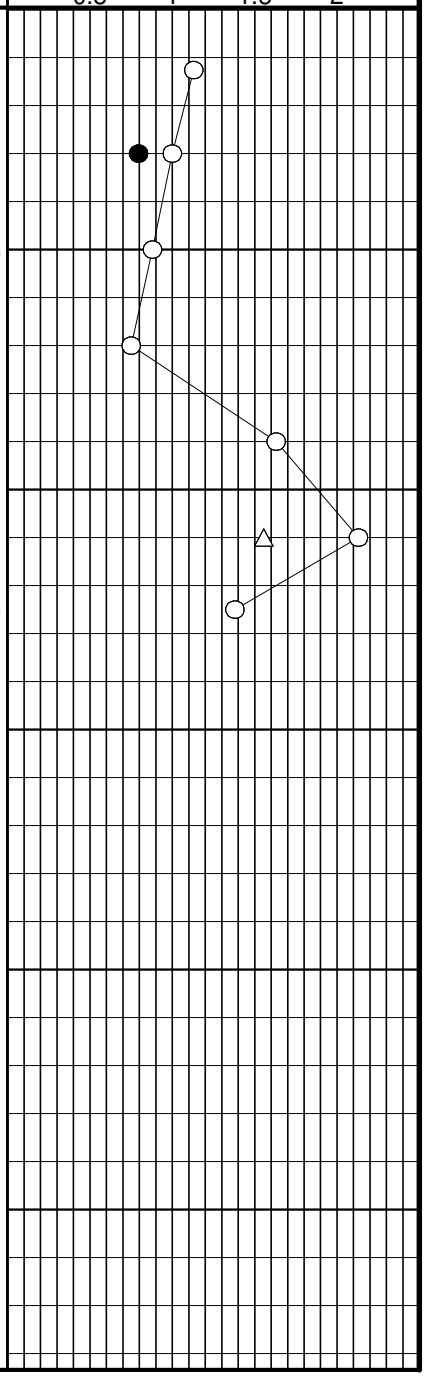
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

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
64	0			*Survey Coordinates (TSPC, Surface):* *Easting: 3072022.00* *Northing: 13824575.92* *Elevation: 64.36* . Pavement: 6.25" concrete							
				Stiff to very stiff, dark gray Fat Clay (CH), with ferrous nodules -tan and gray 2'-4'			108	20			
								21			
60	4			Stiff to hard, tan and gray Lean Clay w/ Sand (CL), with ferrous nodules -with calcareous nodules and siltstone fragments 4'-8'		73		21	49	14	35
								25			
56	8			-tan, light gray, and red 8'-12'				17			
							116	17			
52	12			Light gray and tan Clayey Sand (SC), with ferrous nodules		32		15	29	19	10
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13 **PLATE A-30**

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-75**

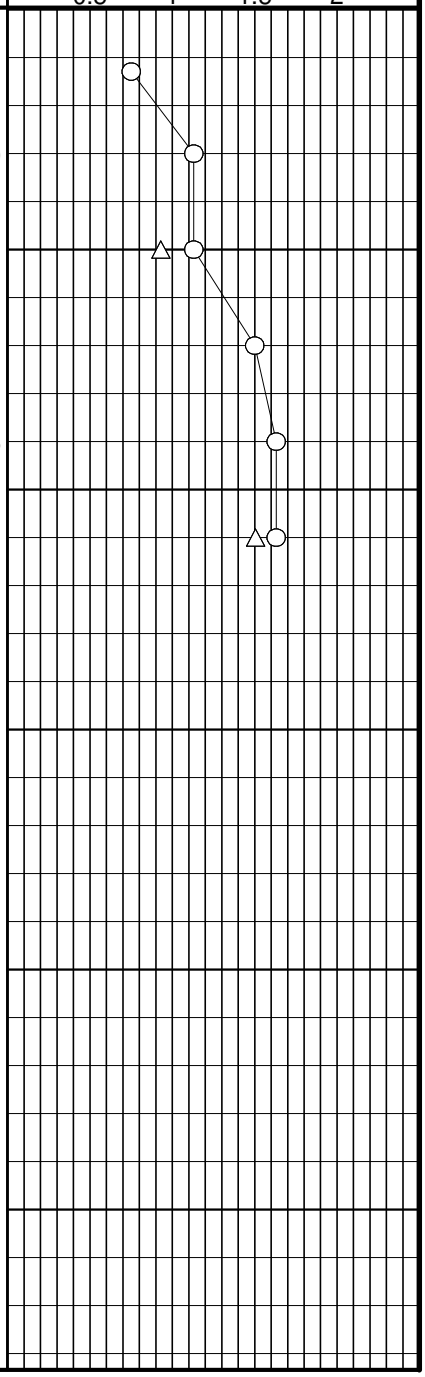
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

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
64	0			Pavement: 7" concrete							
				Stiff to very stiff, dark gray Fat Clay w/Sand (CH)				28			
						81		23	57	17	40
60	4			Stiff to very stiff, gray and tan Sandy Lean Clay (CL)			110	21			
				-with calcareous nodules and siltstone fragments 4'-6'				18			
56	8			-light gray, tan, and red 6'-10', with ferrous nodules 6'-12'		54		15	29	14	15
							119	14			
52	12			Termination depth = 12 feet							
48	16										
44	20										
40	24										
36	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-31

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-76**

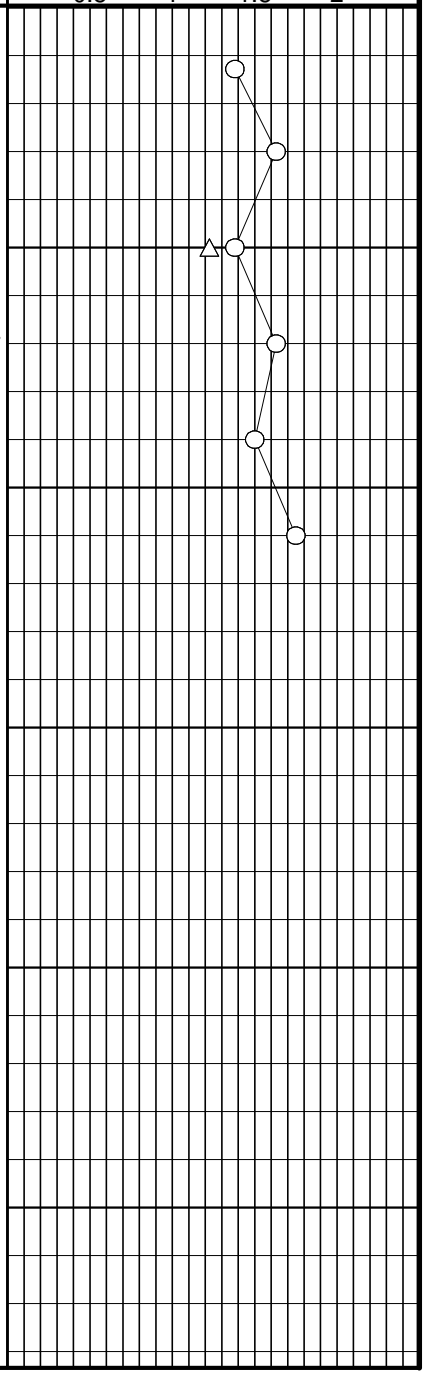
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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
64	0			Pavement: 6.75" concrete							
				Very stiff, light gray and tan Sandy Lean Clay (CL)				15			
				-with abundant calcareous nodules and siltstone fragments 0'-6'				16			
				-with ferrous nodules 2'-4'							
60	4						111	19			
				-with ferrous nodules 6'-12'							
						56		18	41	14	27
56	8							18			
				-light gray, tan, and red 10'-12'							
								15			
52	12			Termination depth = 12 feet							
48	16										
44	20										
40	24										
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-32

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-77**

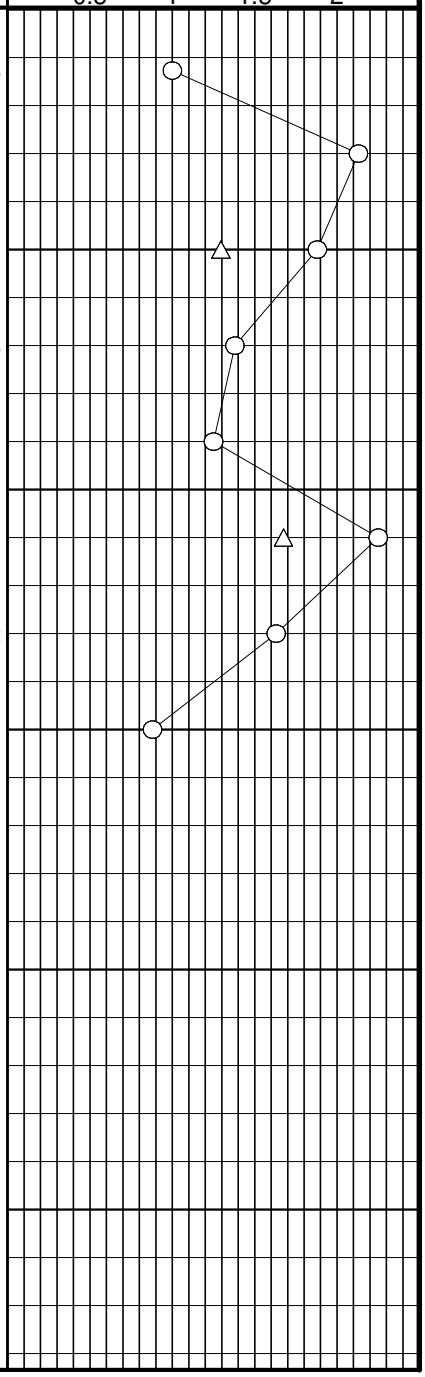
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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							
				Stiff to hard, light gray Lean Clay w/Sand (CL), with abundant calcareous nodules and siltstone fragments		77		16	38	14	24
60	4			-tan and light gray, with ferrous nodules 2'-6'				17			
				-red, brown, and light gray, with fat clay seams 4'-6'			112	20			
				Very stiff to hard, tan and light gray Sandy Lean Clay (CL)		56		16	36	12	24
56	8			-with ferrous nodules 6'-10'				16			
							118	15			
52	12			Light gray, tan, and red Clayey Sand (SC)		49		17	37	15	22
				-light gray and tan 14'-16', wet				19			
48	16			Termination depth = 17 feet							
44	20										
40	24										
36	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **10** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-33

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-78**

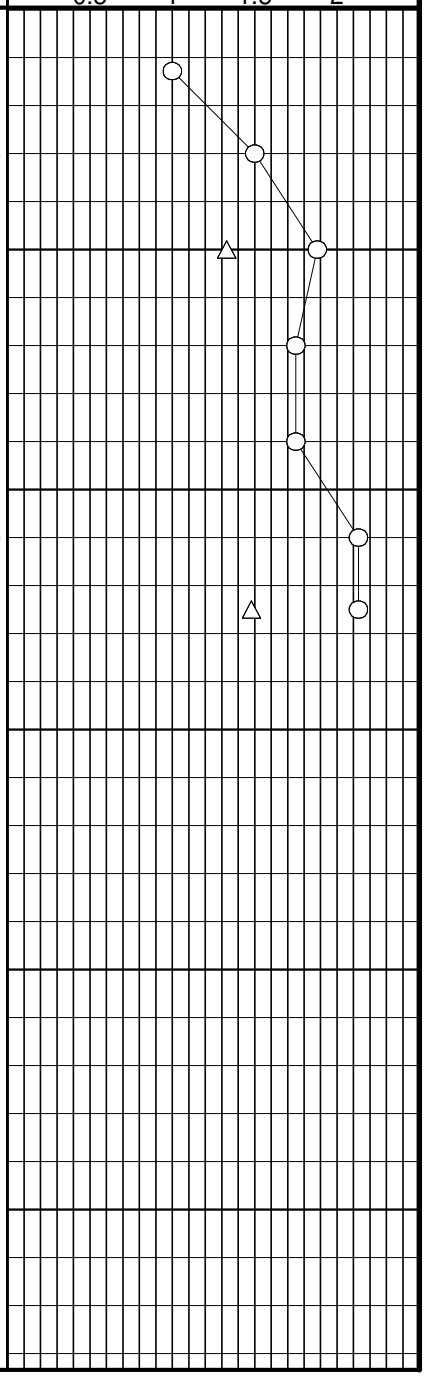
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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
64	0			Pavement: 6.75" concrete							
				Stiff to very stiff, dark gray Lean Clay w/ Sand (CL), with ferrous nodules				21			
				-with abundant siltstone fragments and calcareous nodules 2'-4'		77		17	45	15	30
60	4			Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules			115	16			
				-with calcareous nodules and siltstone fragments 4'-8'				23			
56	8			-tan, light gray, and red 8'-13'				16			
						57		15	31	12	19
52	12						121	14			
				Termination depth = 13 feet							
48	16										
44	20										
40	24										
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-34

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-79**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

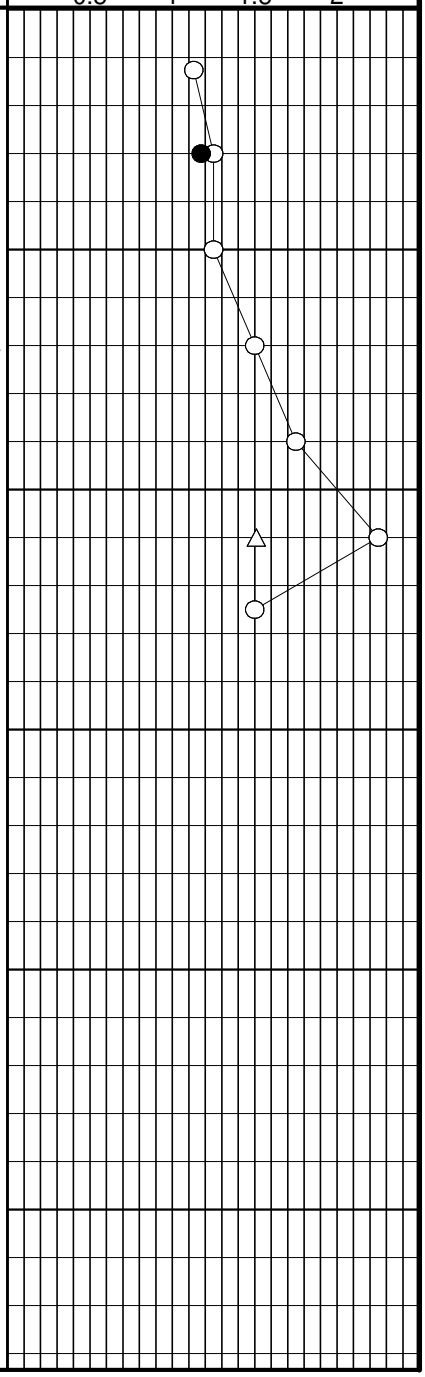
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.25" concrete							
64		Very stiff to hard, dark gray Fat Clay w/ Sand (CH), with slickensides				23			
		-with ferrous nodules 2'-8'			115	20			
	4								
60		-tan and gray, with calcareous nodules and siltstone fragments 4'-8'				21			
				72		18	50	16	34
	8								
56		-red, brown, and light gray 8'-13'				27			
					99	25			
	12								
52		-with silty clay seams 12'-13'				29			
		Termination depth = 13 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072695.25
Northing: 13823747.44
Elevation: 64.75

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-35

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-80**

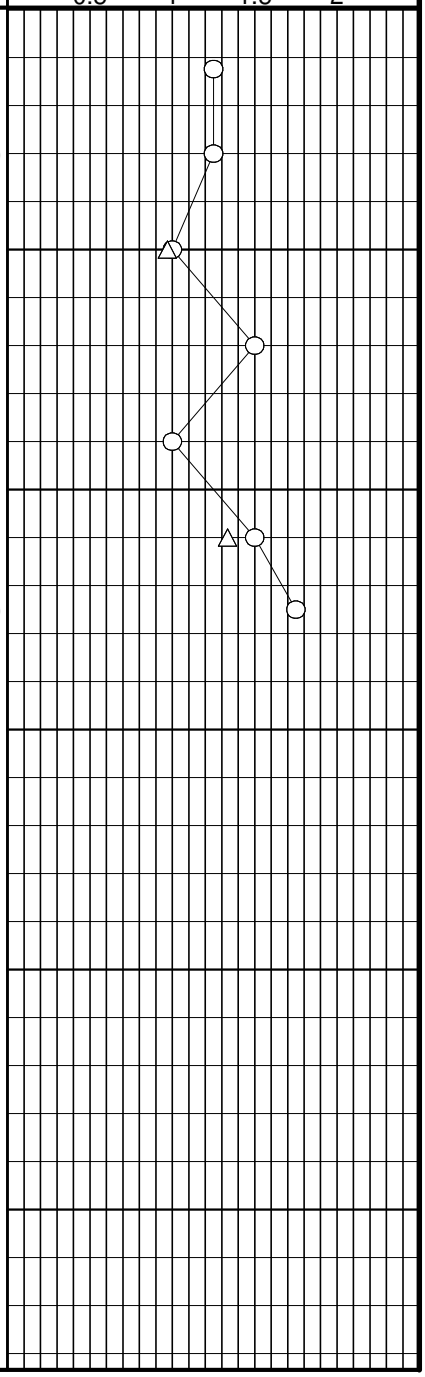
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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
64	0	Pavement: 5.75" concrete							
		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules				22			
		-with calcareous nodules 2'-8'		85		21	57	17	40
60	4	-tan and light gray 4'-10', with abundant siltstone fragments 4'-8'			107	22			
						20			
56	8	-with sandy clay seams 8'-10'				36			
		Very stiff, light gray, tan, and red Sandy Lean Clay (CL)			118	15			
52	12	-light gray and tan 12'-13'		50		16	33	13	20
		Termination depth = 13 feet							
48	16								
44	20								
40	24								
	28								

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-36

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-81**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

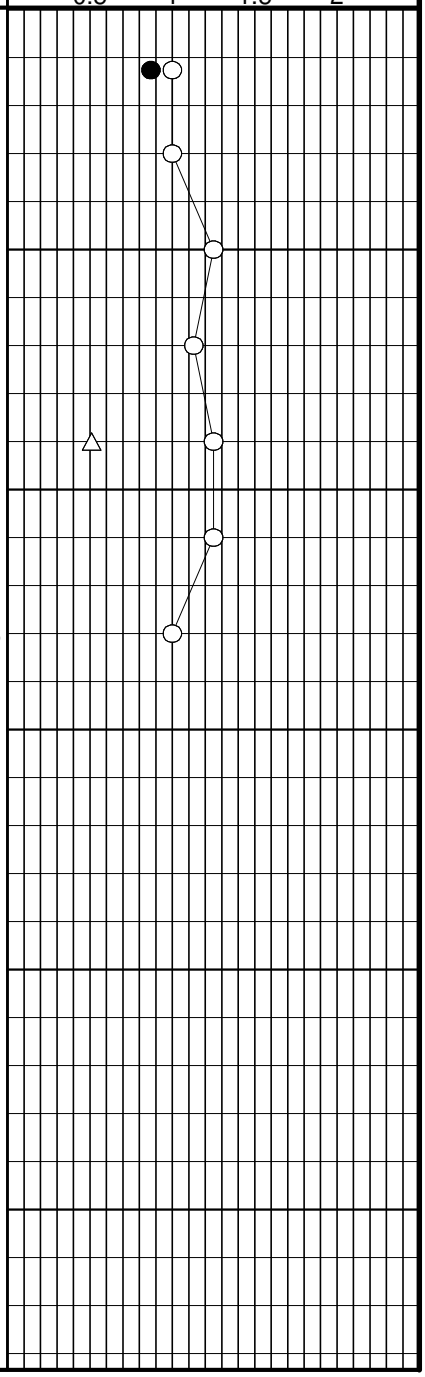
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
64	0	Pavement: 6.25" concrete							
		Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with slickensides			102	24			
						25			
60	4	-dark gray, tan, and light gray, with calcareous nodules 4'-8', and siltstone fragments 4'-12'		71		23	58	17	41
						20			
56	8	-red, brown, and light gray 8'-12', with silt pockets and ferrous nodules 8'-10'			92	32			
		-with silty clay seams 10'-12'				31			
52	12	Very stiff, light gray and tan Sandy Lean Clay (CL), with silt pockets		55		19	29	13	16
		Termination depth = 14 feet							
48	16								
44	20								
40	24								
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072043.10
Northing: 13823662.29
Elevation: 64.60

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 **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **12** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-37

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-82**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

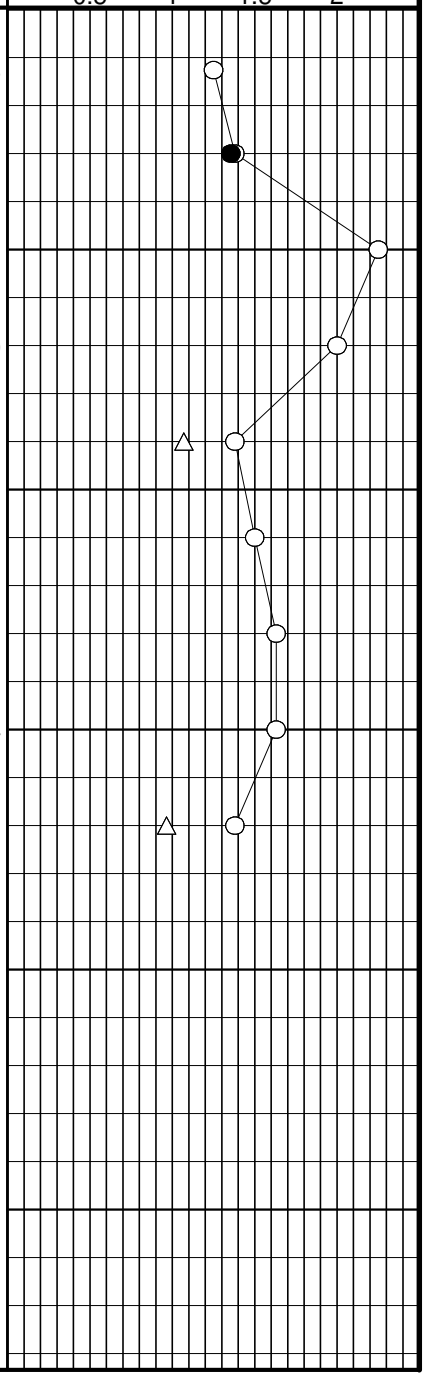
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
64	0	Pavement: 6.25" concrete							
		Very stiff, dark gray Fat Clay (CH), with ferrous nodules		89		23	61	18	43
		-gray and tan, with abundant calcareous nodules and siltstone fragments 2'-4'			108	21			
60	4	Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with abundant calcareous and ferrous nodules, and siltstone fragments				17			
				53		14	47	17	30
56	8	Stiff to very stiff, brown and light gray Fat Clay (CH), with slickensides			107	22			
		-with silty clay seams and siltstone fragments 8'-10'							
		-with silty clay pockets 10'-12'				28			
52	12	-with silt pockets 12'-14'							
						30			
				97		27	55	21	34
48	16				95	28			
		Termination depth = 18 feet							
44	20								
40	24								
36	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072674.23
Northing: 13823471.58
Elevation: 64.15

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-38

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-83**

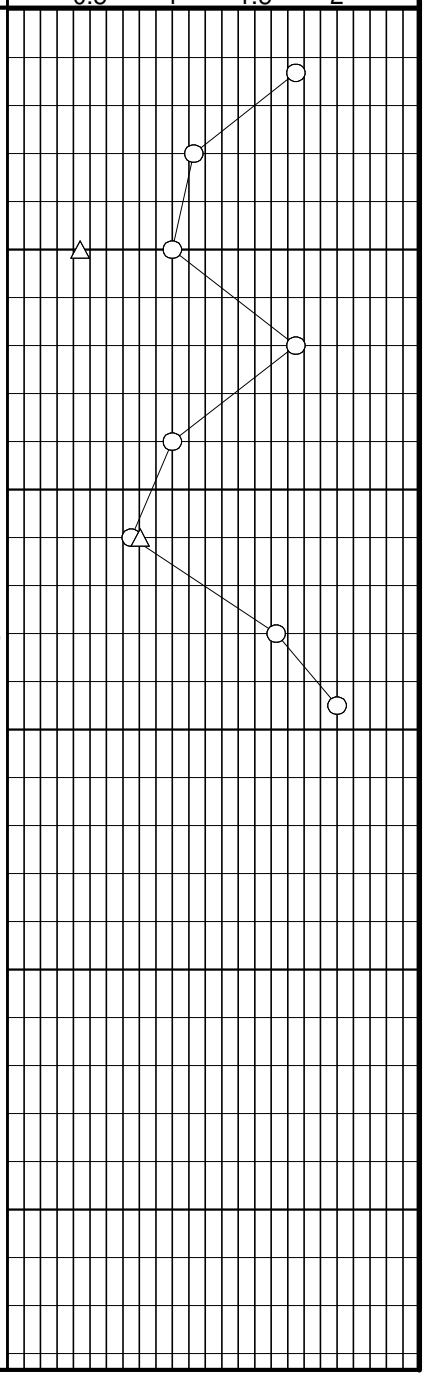
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

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
64	0			Pavement: 7.625" concrete							
				Fill: very stiff, gray Sandy Lean Clay (CL) with siltstone fragments and calcareous nodules				17			
				Firm to very stiff, gray and tan Lean Clay w/ Sand (CL), with calcareous and ferrous nodules, and siltstone fragments		79		19	45	14	31
60	4						102	21			
								16			
56	8			Stiff to hard, tan and brown Lean Clay (CL), with slickensides and silt partings				22			
				-red, brown, and light gray, with siltstone fragments 10'-15' and calcareous nodules 10'-14'			107	23			
52	12			-with clay pockets 12'-15'		100		24	43	18	25
								23			
				Termination depth = 15 feet							
48	16										
44	20										
40	24										
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-39

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-84**

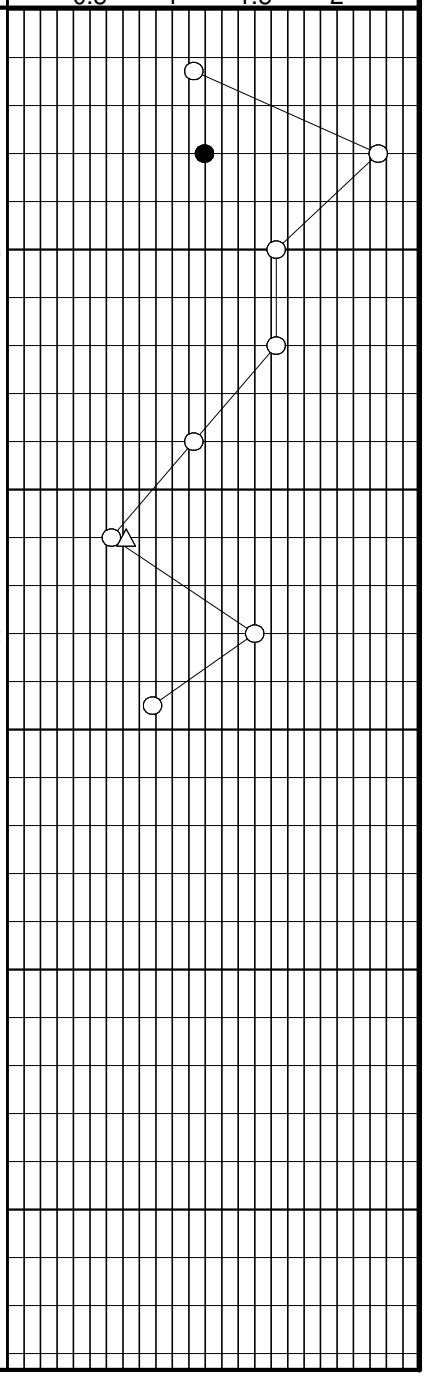
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

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
64	0	Pavement: 6.75" concrete							
		Very stiff to hard, tan and gray Sandy Lean Clay (CL)				20			
		-with abundant calcareous and ferrous nodules, and siltstone fragments 2'-6'			116	15			
60	4			51		17	40	14	26
		-tan, light gray, and red 6'-10', with silt partings 6'-12'				20			
56	8					15			
					115	18			
52	12	Tan and light gray Clayey Sand (SC), with silt partings, wet		39		14	28	16	12
						16			
48	16	Termination depth = 15 feet							
44	20								
40	24								
	28								

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 **15** FEET WHILE DRILLING ▽
WATER LEVEL AT **10** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-40

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-85**

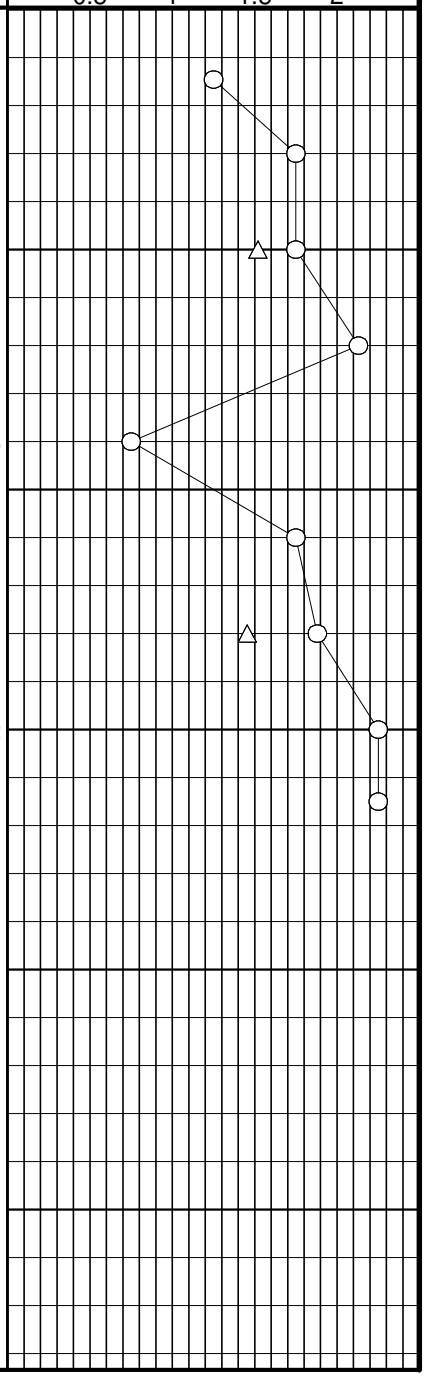
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

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
64	0			Pavement: 7" asphalt				17			
				Base: 4" lime-stabilized clayey sand, with gravel							
				Very stiff to hard, gray and light gray Lean Clay w/Sand (CL)		75		17	34	13	21
60	4			-light gray and tan 4'-8', with vertical sand parting 4'-6'			112	18			
								18			
56	8			Light gray, tan, and red Clayey Sand (SC)		43		23	29	13	16
				-with ferrous nodules 10'-14'				16			
52	12						120	14			
						40		14	35	13	22
48	16							14			
				Termination depth = 17 feet							
44	20										
40	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **n/a** FEET WHILE DRILLING ▽
WATER LEVEL AT **n/a** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-41

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-86**

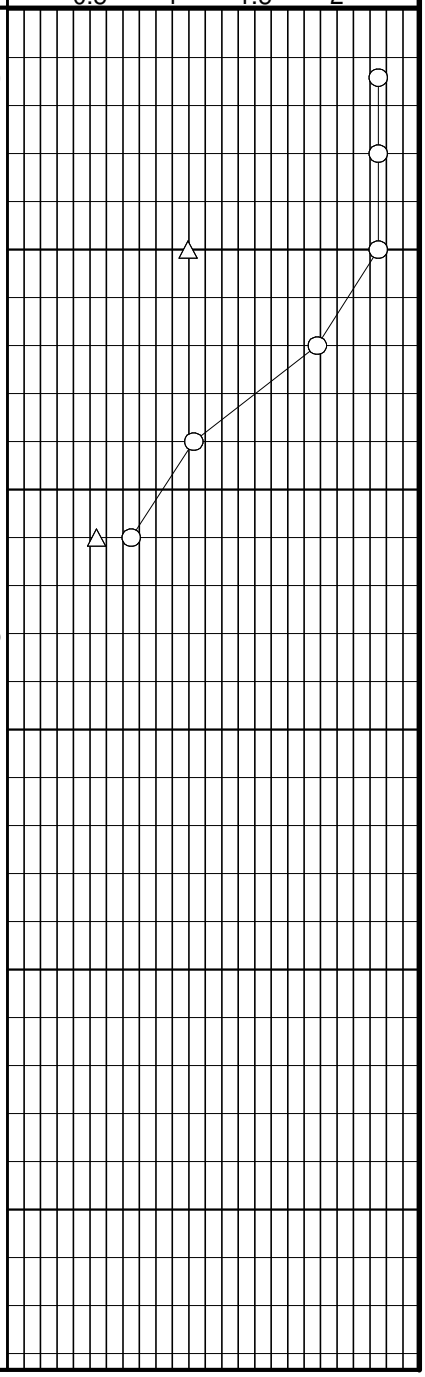
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

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
64	0			Pavement: 4" asphalt							
				Base: 6" stabilized clayey sand, with gravel		65		15	35	15	20
	4			Very stiff to hard, dark gray Sandy Lean Clay (CL) -with abundant calcareous nodules and siltstone fragments 2'-6' -light gray 4'-6'			123	12 9			
60	8			Tan and light gray Clayey Sand (SC), with abundant calcareous nodules and siltstone fragments -with silt partings 8'-12'		48		16 16	36	15	21
56	12			Tan Silty Sand (SM), wet		45	102	23 19	np	np	np
52	16			Termination depth = 15 feet							
48	20										
44	24										
40	28										

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 **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **12** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-42

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-87**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

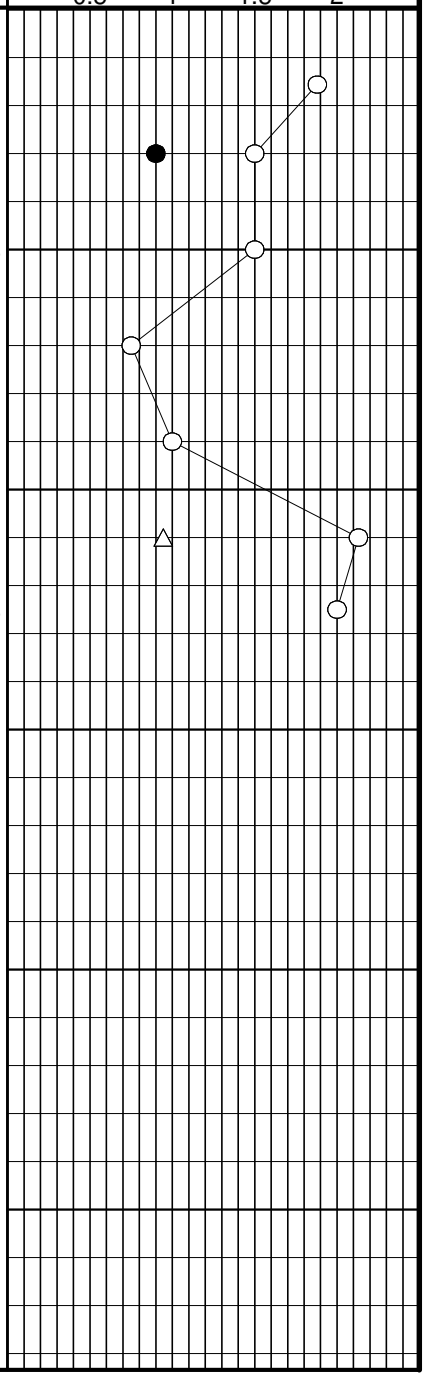
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.5" concrete							
64		Base: 7" stabilized gravel							
		Stiff to very stiff, light gray Lean Clay w/ Sand (CL)				15			
		-with abundant siltstone fragments and calcareous nodules 1'-4'			111	17			
	4	-tan and light gray 2'-4', with ferrous nodules 2'-8'							
60		-tan 4'-6'		73		18	38	15	23
		-gray and tan, wtih siltstone fragments 6'-8'				21			
	8	Stiff to hard, red, brown, and light gray Fat Clay (CH), with siltstone fragments and silty clay pockets				29			
56		-with calcareous nodules 8'-12'			106	22			
	12			99		23	56	23	33
52		Termination depth = 13 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3073456.09
Northing: 13823150.11
Elevation: 65.06

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 **10** FEET WHILE DRILLING ▽
WATER LEVEL AT **12.3** FEET AFTER **COMPLETE** ▼
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-43

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-88**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

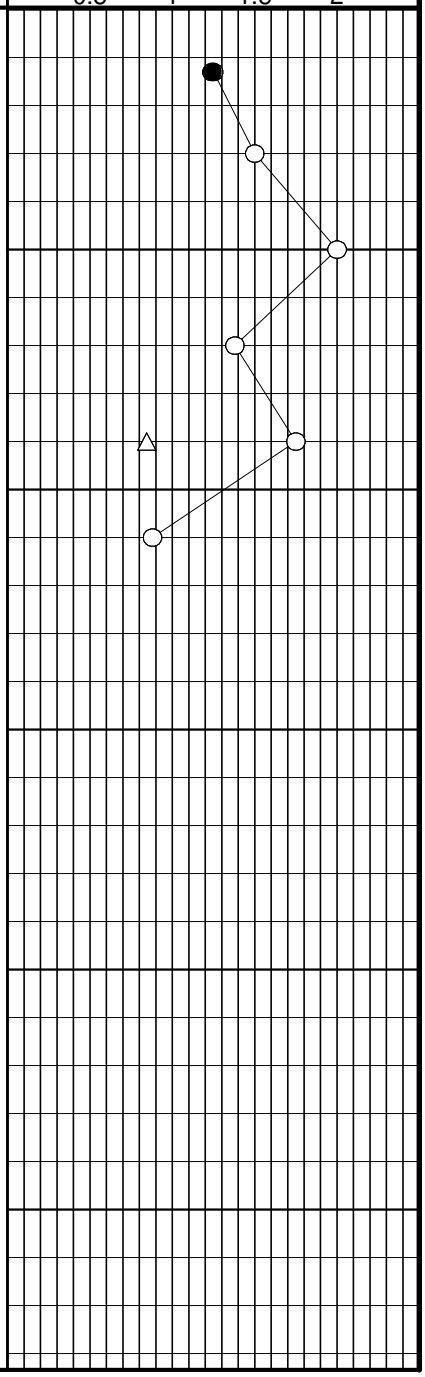
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7.25" concrete							
64		Very stiff to hard, dark gray Lean Clay w/ Sand (CL), with ferrous nodules			108	21			
		-gray and tan 2'-8'				21			
	4	-with siltstone fragments 4'-8'							
60				83		19	48	15	33
						20			
	8	Stiff to very stiff, red, brown, and light gray Fat Clay (CH), with siltstone fragments			100	26			
56		-with calcareous and ferrous nodules 8'-10'							
		-with silt partings 10'-12'				26			
	12	Termination depth = 12 feet							
52									
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3073105.02
Northing: 13823135.30
Elevation: 65.44

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 **8** FEET WHILE DRILLING ▽
WATER LEVEL AT **11.4** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-44

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-89**

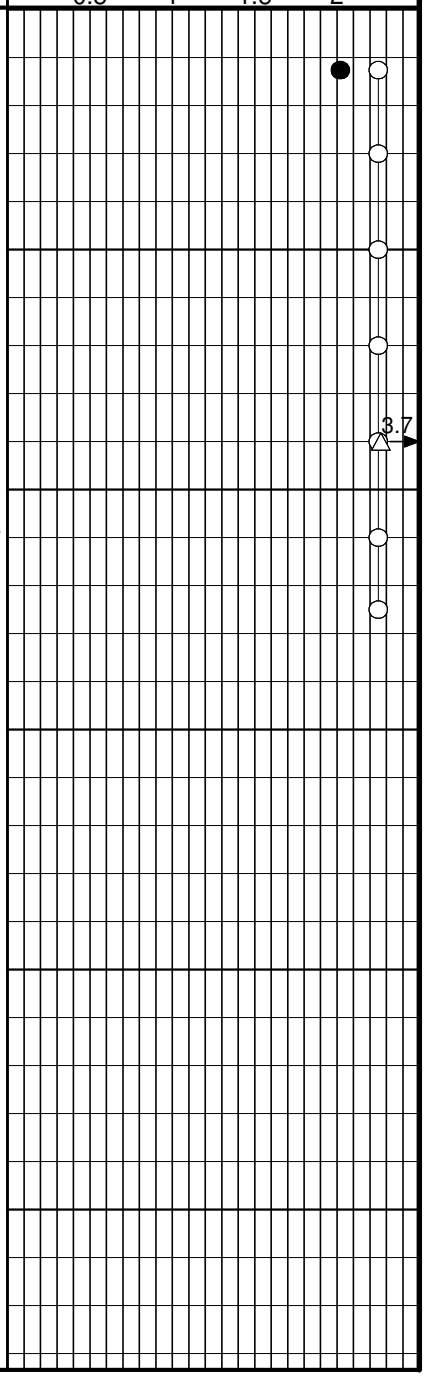
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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
64	0			Pavement: 6.25" concrete							
				Hard, gray Sandy Lean Clay (CL), with abundant calcareous and ferrous nodules, and siltstone fragments			117	12			
				-light gray and tan 2'-6'		65		10	34	13	21
60	4							9			
				Hard, red, brown, and light gray Fat Clay (CH), with slickensides and calcareous nodules				16			
	8			-with sandy clay seams and ferrous nodules 6'-8'							
56				-with silt pockets 8'-10'			114	16			
				-with abundant silt seams 10'-12'		98		19	62	25	37
	12			-with silty clay seams 12'-13'				20			
52				Termination depth = 13 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3072553.44
Northing: 13823124.69
Elevation: 65.37

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-45

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-90**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

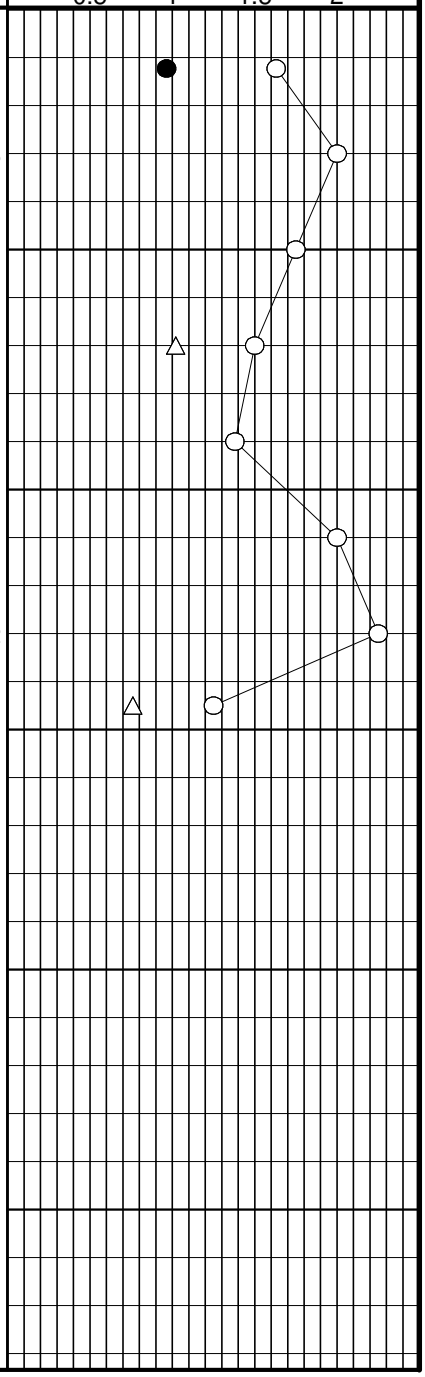
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 5.5" concrete							
64		Stiff to hard, tan and gray Sandy Lean Clay (CL), with ferrous nodules			112	17			
		-with silt pockets 0'-2'							
		-with siltstone fragments and calcareous nodules 2'-6'		62		15	42	14	28
	4	-gray, tan, and red 4'-6'							
60						18			
		-tan and gray 6'-8'			111	17			
	8	Tan, red, and light gray Clayey Sand (SC), with silt partings				17			
56									
						15			
	12								
52				37		15	36	14	22
					116	18			
		Termination depth = 15 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072082.70
Northing: 13823107.32
Elevation: 65.06

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 **15** FEET WHILE DRILLING ▽
WATER LEVEL AT **13** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-46

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-91**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

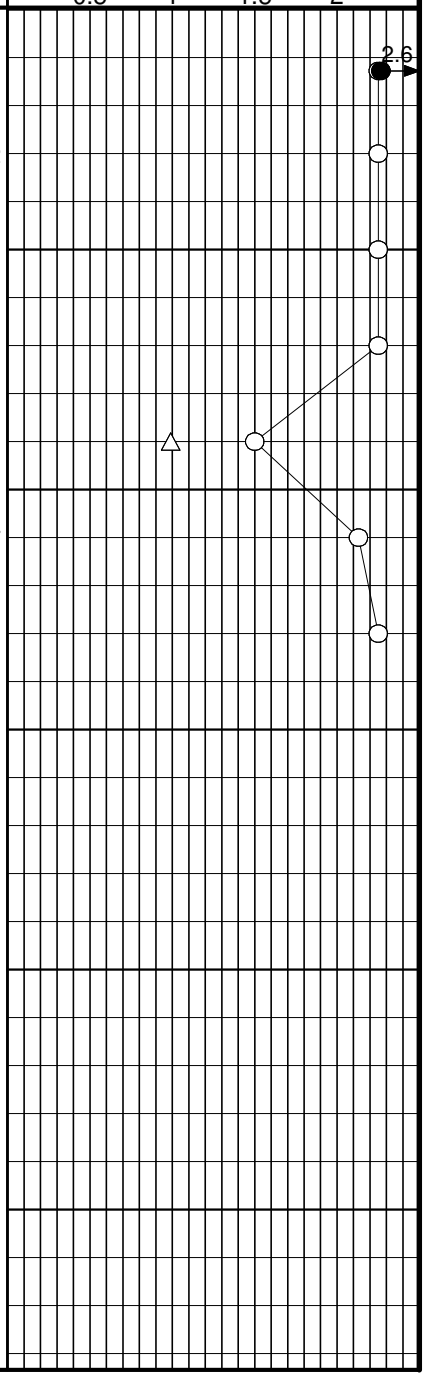
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
65	0			Pavement: 6.625" concrete							
64				Hard, tan and gray Lean Clay w/Sand (CL), with ferrous nodules			115	14			
				-light gray and tan 2'-8'		78		12	47	15	32
	4			-with sand seams 4'-6'				13			
60								18			
	8			Stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules			115	15			
56				-light gray, tan, and red 10'-14'		56		15	40	13	27
	12										
52								14			
				Termination depth = 14 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3072189.20
Northing: 13822811.52
Elevation: 65.07

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-47

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-92**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

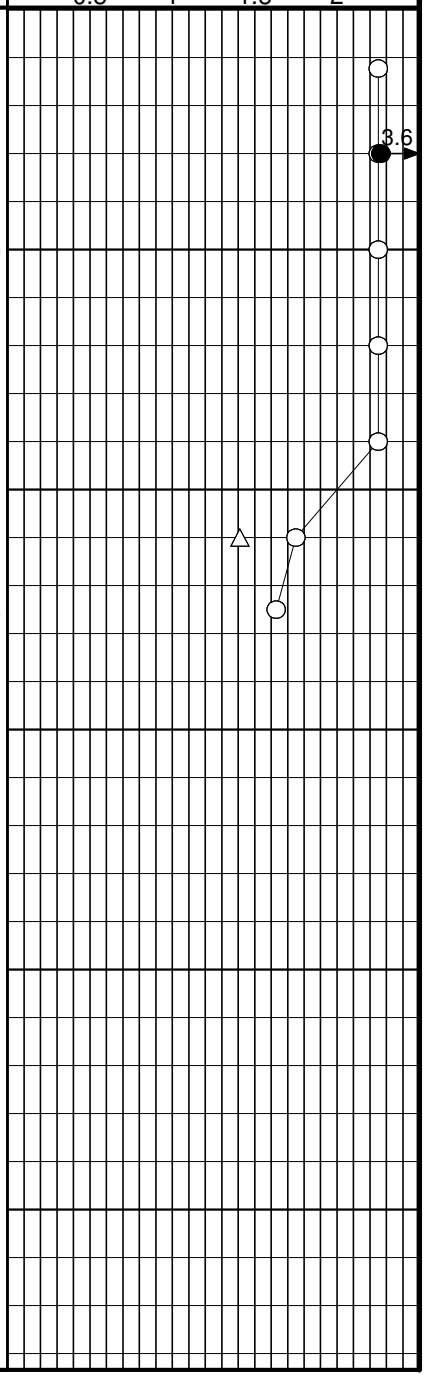
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 5.5" concrete							
64		Very stiff to hard, dark gray Lean Clay (CL), with sand partings				17			
		-gray and tan 2'-8', with abundant calcareous nodules and siltstone fragments 2'-6', and ferrous nodules 2'-8'			114	14			
	4			87		15	46	16	30
60						15			
	8	-light gray, tan, and red 8'-13', with calcareous nodules and roots 8'-10'				18			
56		-with silt partings ans siltstone fragments 10'-13'			105	17			
	12	-with calcareous nodules 12'-13'		100		20	42	19	23
52		Termination depth = 13 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072682.16
Northing: 13822740.76
Elevation: 65.33

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-48

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-93**

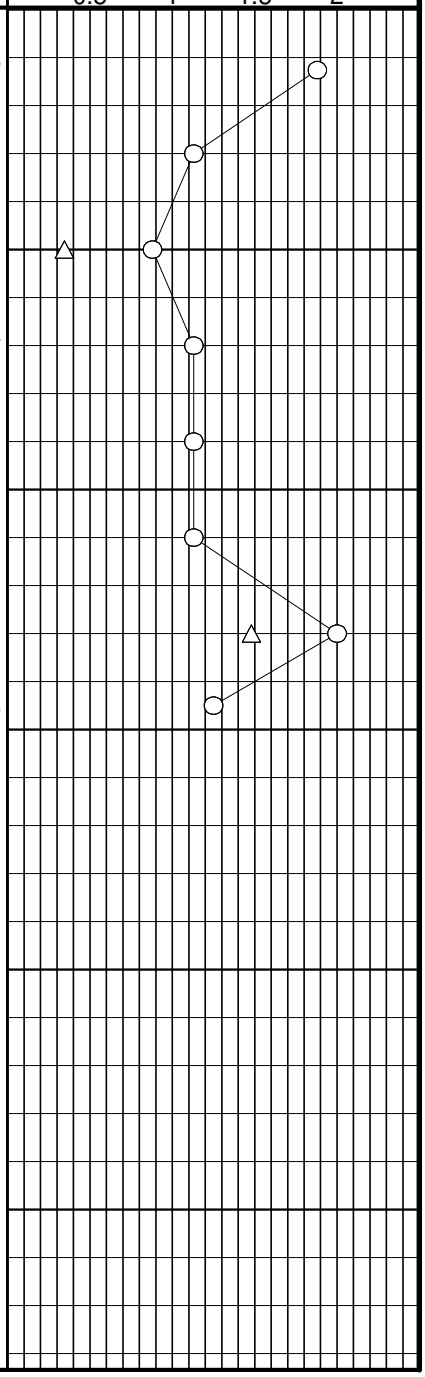
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/26/2014**

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: 6.25" concrete							
64	4	Firm to very stiff, gray Sandy Fat Clay (CH), with calcareous and ferrous nodules, and siltstone fragments -light gray and tan 2'-6'		61	105	19 21 22	52	15	37
60	8	Very stiff, red, brown, and light gray Lean Clay (CL), with silt partings, calcareous and ferrous nodules, and siltstone fragments -wet at 8'		88		19 23	33	16	17
56	12	Very stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides, silt partings, and siltstone fragments -with calcareous nodules 12'-14'		100	102	25 25 26	62	24	38
52	16	Termination depth = 15 feet							
48	20								
44	24								
40	28								

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 **8** FEET WHILE DRILLING ▽
WATER LEVEL AT **12.5** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-49

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-94**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

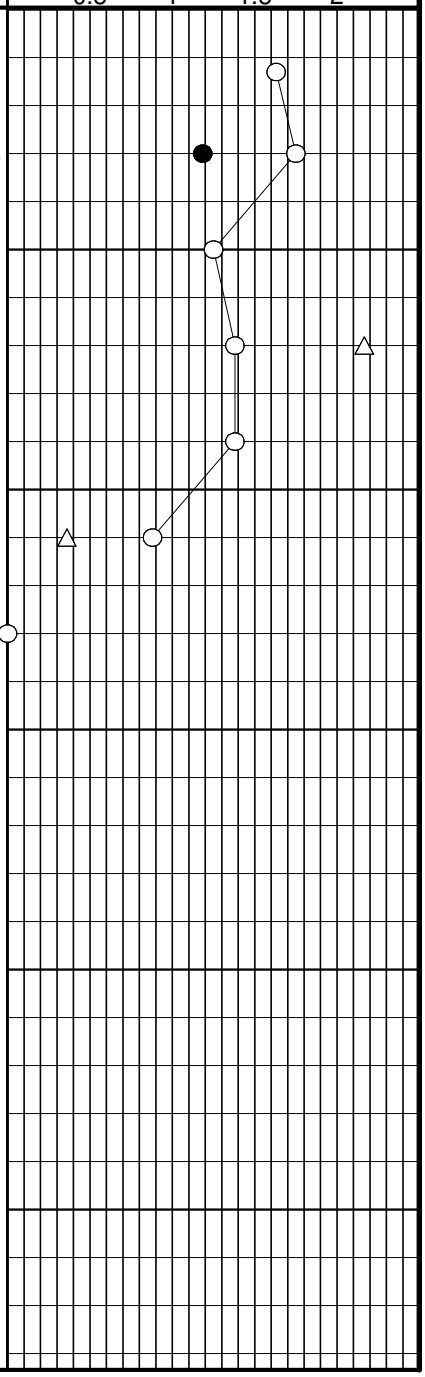
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **6/27/2014**

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							
				Very stiff to hard, tan and gray Lean Clay w/ Sand (CL)				17			
64						74	113	16	43	15	28
	4			-with sand seams 4'-6'				18			
60				-with sand pockets and ferrous nodules 6'-8'			116	16			
	8			Firm to very stiff, light gray Sandy Lean Clay (CL), with silt partings				21			
56						68	99	18	28	20	8
	12			Light gray Clayey Sand (SC), wet		25		24			
52				Termination depth = 14 feet							
	16										
48											
	20										
44											
	24										
40											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3073700.02
Northing: 13822780.05
Elevation: 66.73

BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **10.5** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-50

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **WL Repl. Sharpstown Estates Country Club Area** BORING **B-95**

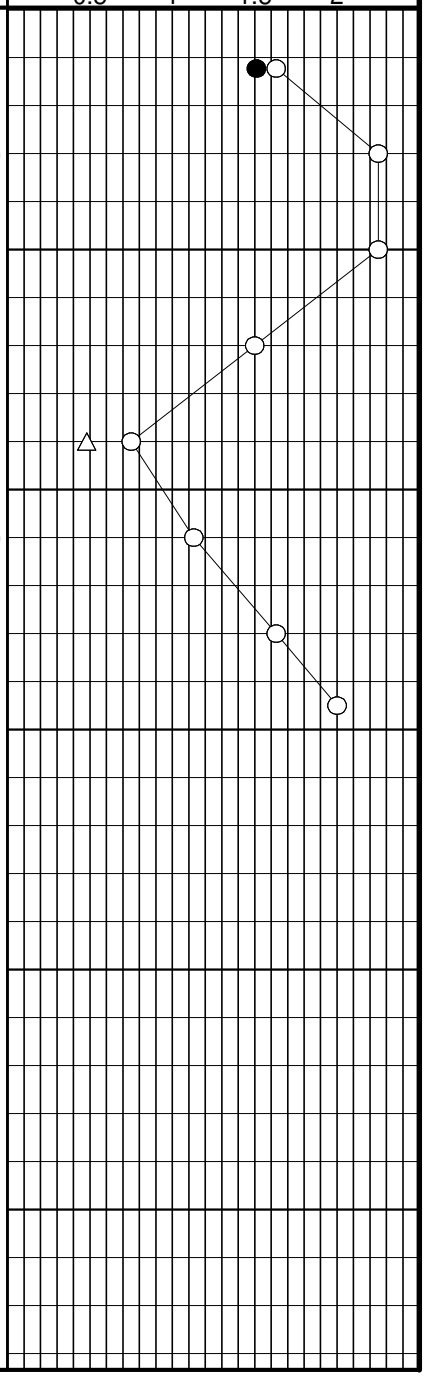
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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
64	0			Pavement: 5.5" concrete							
				Very stiff to hard, gray and tan Lean Clay w/ Sand (CL), with calcareous and ferrous nodules			112	17			
				-with siltstone fragments 2'-8'		83		15	46	16	30
60	4							15			
								21			
56	8			Firm to hard, light gray and tan Sandy Lean Clay (CL)			107	18			
				-with silt partings 8'-10'							
				-tan, light gray, and red, with ferrous nodules 10'-14'		56		17	33	14	19
52	12							16			
								15			
48	16			Termination depth = 15 feet							
44	20										
40	24										
	28										

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 **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **12** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-51

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-96**

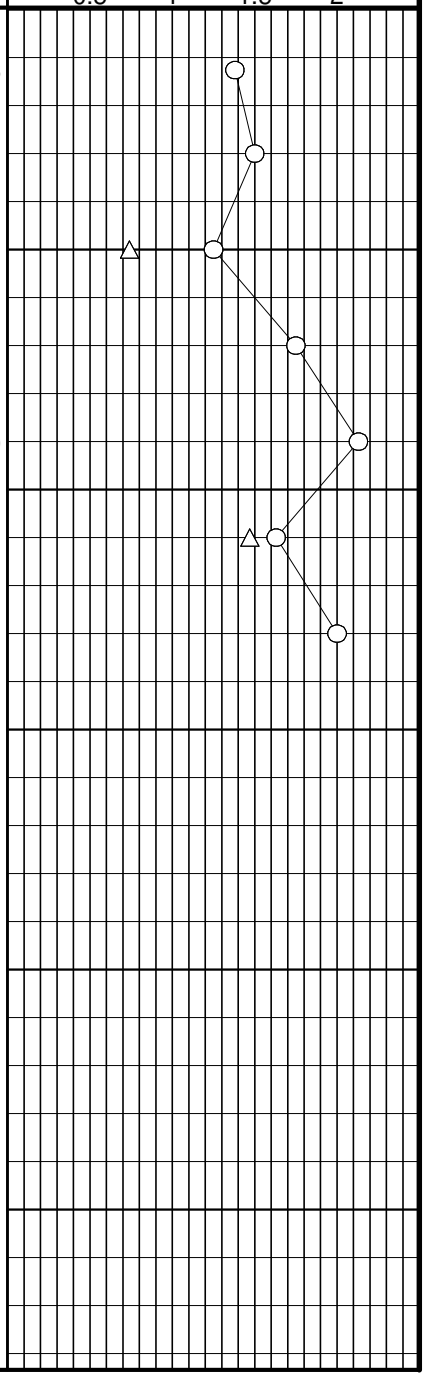
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/8/2014**

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: 6.25" concrete							
64				Stiff to very stiff, gray and tan Lean Clay w/ Sand (CL), with sand pockets and ferrous nodules		81		19	39	13	26
	4							19			
60							108	19			
	8			Very stiff to hard, light gray, tan, and red Sandy Lean Clay (CL), with ferrous nodules				19			
56						66		16	44	14	30
	12			-with silt pockets 12'-14'			118	15			
52								14			
				Termination depth = 14 feet							
48	16										
	20										
44											
	24										
40											
	28										

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-52

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-97**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/1/2014**

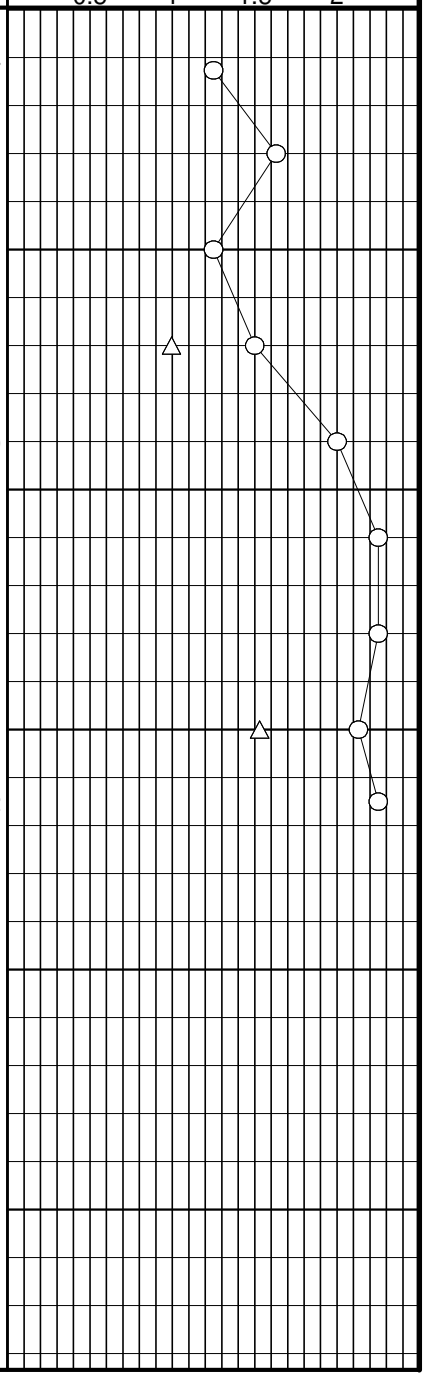
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6.375" concrete							
64		Stiff to very stiff, gray Lean Clay w/Sand (CL)		81		20	42	15	27
		-with silt pockets 0'-4'				15			
	4	-light gray and tan 2'-6'							
60						16			
		-light gray, tan, and red, with sand seams 6'-8'			108	17			
	8								
56		Very stiff to hard, light gray, tan, and red Sandy Lean Clay (CL)		65		16	44	14	30
		-with ferrous nodules 8'-14'				14			
	12								
52						15			
					116	16			
	16			51		14	47	15	32
48		Termination depth = 17 feet							
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3072102.25
Northing: 13822606.98
Elevation: 65.22

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **16** FEET WHILE DRILLING ▽
WATER LEVEL AT **13** FEET AFTER **COMPLETE** ▽
DRILLED BY **JH Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-53

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-98**

COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

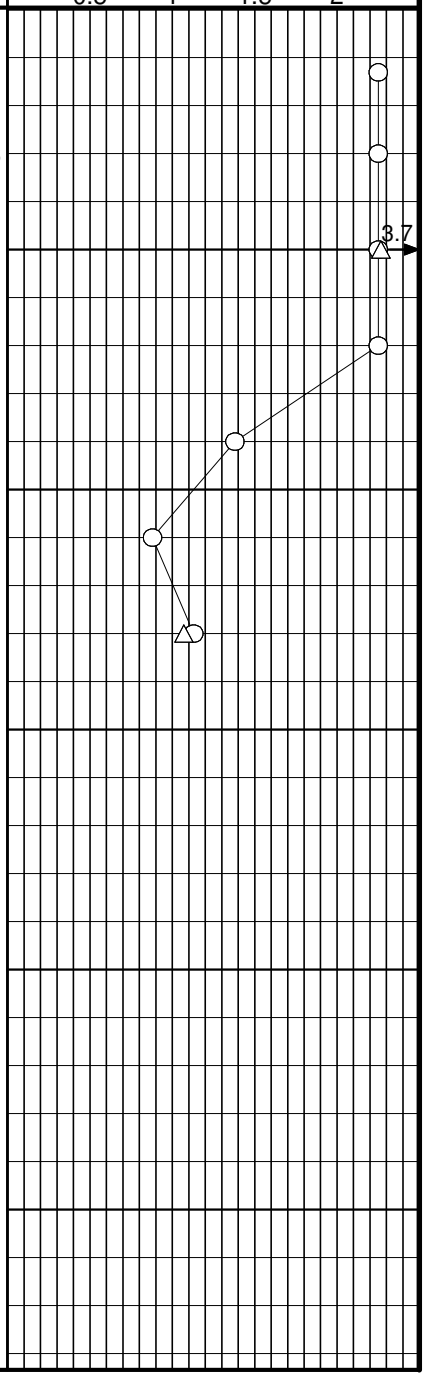
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7.375" concrete							
64		Hard, dark gray Fat Clay w/Sand (CH), with ferrous nodules				15			
				84		15	53	17	36
	4				113	16			
60		-gray and tan, with siltstone fragments 6'-8'				18			
	8	Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules				23			
56		-with calcareous nodules and siltstone fragments 8'-10'							
		-with silt partings 10'-12'		66		22	35	14	21
	12				109	20			
52		Termination depth = 14 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3070667.35
Northing: 13825747.25
Elevation: 65.83

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-54

PROJECT: **WL Repl. Sharpstown Estates Country Club Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-99**

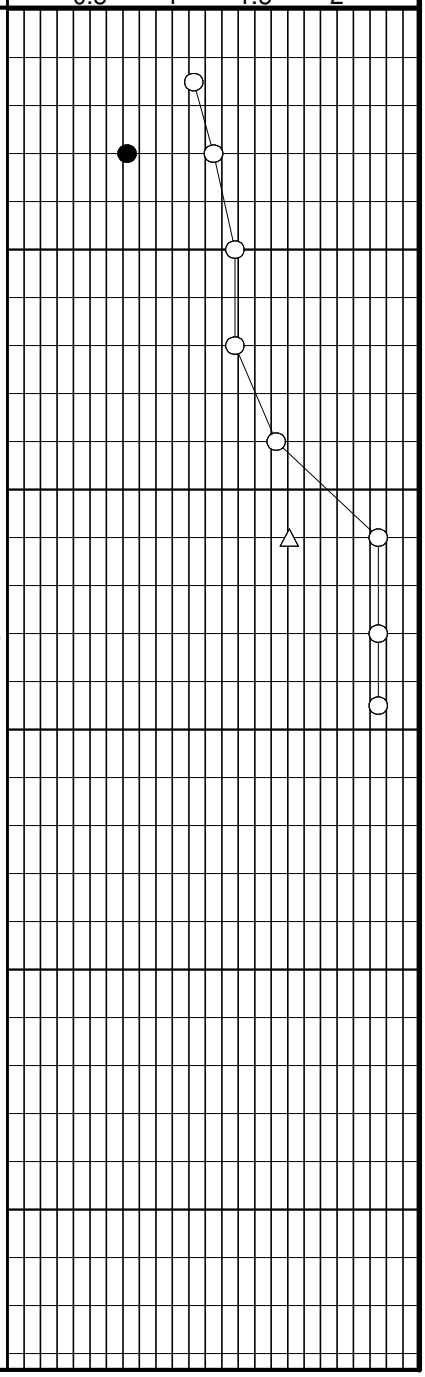
COH WBS No. **S-000035-0173-3** TYPE **4" Dry Auger** DATE **7/7/2014**

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: 6.125" concrete							
		Base: 6.125" stabilized base							
64		Stiff to very stiff, dark gray Fat Clay (CH), with slickensides and ferrous nodules				23			
					103	22			
	4	-with siltstone fragments 4'-8'							
				86		23	57	16	41
60		-light gray and tan 6'-8'							
						27			
	8	Very stiff to hard, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules				17			
56		-with calcareous nodules and siltstone fragments 8'-10'							
					121	14			
	12								
				76		16	38	13	25
52		-with sand pockets 14'-15'							
						15			
		Termination depth = 15 feet							
	16								
48									
	20								
44									
	24								
40									
	28								

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 Drilling** DRAFTED BY **CHL/WW** LOGGED BY **CHL**

PROJECT NO. G110-13

PLATE A-55

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Paving
	Low plasticity clay
	Fill
	High plasticity clay
	Poorly graded clayey silty sand
	Clayey sand
	Poorly graded sand with silt
	Silty sand
Misc. Symbols	
○	Pocket Penetrometer
●	Unconfined Compression
△	Confined Compression
	Water table depth during drilling
	Subsequent water table depth
Soil Samplers	
	Rock core

Symbol	Description
	Undisturbed thin wall Shelby tube
	Auger
	Standard penetration test

AYLES ENGINEERING CORP.

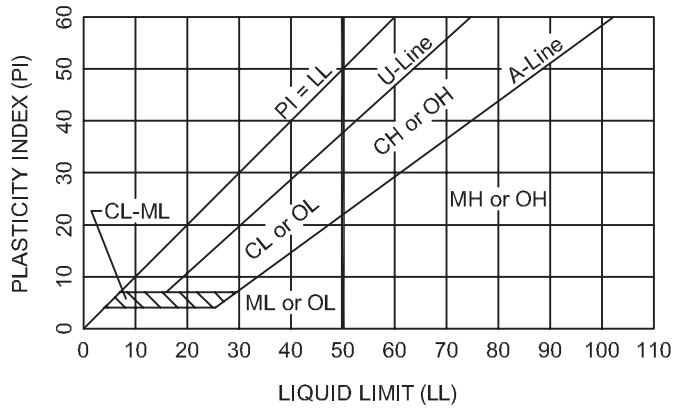
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

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

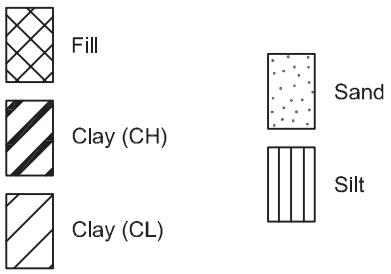


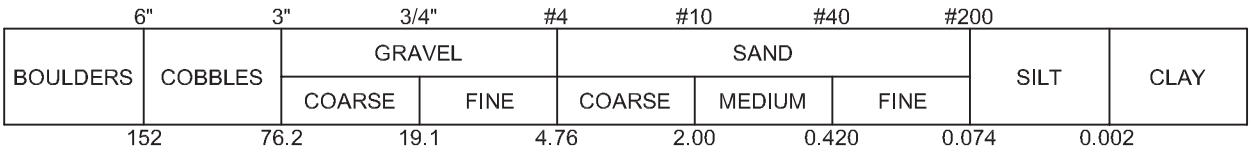
PLATE A-57

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 LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-47	0-2	20				45	14	31	71.4
	2-4	19	108.3	2.04					
	4-6	16							
	6-8	21							
	8-10	16				31	14	17	60.4
	10-12	15	119.5		1.31 (7)				
	12-13	16							
B-48	0-2	19				47	14	33	79.6
	2-4	19							
	4-6	20	110.3		2.91 (3)				
	6-8	18							
	8-10	16				33	12	21	68.7
	10-12	16							
	12-14	16							
	14-16	15	118.4		3.22 (10)				
	16-17	15				32	13	19	67.7
B-49	0-2	28							
	2-4	23				59	17	42	82.9
	4-6	23	102.9		1.92 (3)				
	6-8	24							
	8-10	23							
	10-12	18				36	12	24	73.4
	12-14	18	115.0		3.60 (9)				
B-50	0-2	22							
	2-4	24	101.1	1.96					
	4-6	26				65	18	47	89.7
	6-8	26							
	8-10	26							
	10-12	33	97.6		1.59 (7)				
	12-13	15				39	14	25	72.6

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-51	0-2	No Sample							
	2-4	23				58	17	41	77.8
	4-6	26	98.8		2.12 (3)				
	6-8	25							
	8-10	16				37	13	24	65.1
	10-12	17	105.3		1.01 (7)				
	12-14	15							
	14-15	19				26	20	6	31.0
B-52	0-2	25				63	20	43	87.9
	2-4	24	97.7	1.48					
	4-6	26							
	6-8	25				58	17	41	85.7
	8-10	16	113.1		1.95 (6)				
	10-12	21							
	12-14	15				33	14	19	66.4
	14-16	16	115.0		2.90 (10)				
B-53	0-2	22							
	2-4	26	99.5	1.18					
	4-6	27				61	19	42	85.6
	6-8	30							
	8-10	18							
	10-12	17	115.8		2.43 (7)				
	12-14	14				40	13	27	64.9
	14-15	18							
B-54	0-2	19							
	2-4	18				56	16	40	76.9
	4-6	20	110.5		2.28 (3)				
	6-8	15							
	8-10	15							
	10-12	16				28	15	13	38.0
	12-14	15	117.2		2.47 (9)				
	14-15	18							

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-55	0-2	17				48	14	34	72.8
	2-4	14							
	4-6	12	118.5		4.98 (3)				
	6-8	16				39	14	25	51.9
	8-10	16							
	10-12	15	119.9		2.85 (7)				
	12-14	13				31	16	15	44.2
B-56	0-2	15				39	14	25	68.3
	2-4	18							
	4-6	17	114.7		2.47 (3)				
	6-8	16				34	12	22	65.2
	8-10	16							
	10-12	18	115.1		2.37 (7)				
	12-14	17							
	14-16	18				24	20	4	24.4
B-57	0-2	13	119.3	1.73					
	2-4	16							
	4-6	19				49	16	33	77.6
	6-8	15							
	8-10	15	119.4		3.38 (6)				
	10-12	14							
B-58	0-2	16							
	2-4	17	112.6	3.47					
	4-6	16				46	14	32	51.2
	6-8	20							
	8-10	16							
	10-12	15	119.0		1.94 (7)				
	12-13	13				31	14	17	43.0
B-59	0-2	20							
	2-4	19				65	17	48	89.0
	4-6	21	109.3		4.06 (3)				
	6-8	18							
	8-10	15							
	10-12	13				31	12	19	45.2
	12-13	12	120.5		3.38 (8)				

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-60	0-2	22				57	16	41	75.7
	2-4	23	103.4	1.70					
	4-6	25							
	6-8	15							
	8-10	16				29	13	16	52.8
	10-12	16	117.9		1.43 (7)				
	12-13	17							
B-61	0-2	24							
	2-4	23				60	18	42	85.0
	4-6	22	103.9		1.86 (3)				
	6-8	25							
	8-10	15							
	10-12	13				35	12	23	68.6
	12-14	19	113.8		3.77 (9)				
B-62	0-2	20				49	16	33	76.2
	2-4	27	96.3	1.63					
	4-6	24							
	6-8	21							
	8-10	17				34	12	22	61.6
	10-12	17	117.0		2.17 (7)				
	12-14	16							
B-63	0-2	27							
	2-4	23	101.7	1.39					
	4-6	27				62	17	45	81.5
	6-8	26							
	8-10	20							
	10-12	24	104.5		1.02 (7)				
	12-14	15				26	18	8	25.7
	14-16	16							
B-64	0-2	19				48	15	33	76.9
	2-4	25	101.0	1.36					
	4-6	25							
	6-8	23				62	19	43	83.2
	8-10	18	114.7		2.28 (6)				
	10-12	14							
	12-14	15				36	13	23	53.5

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-65	0-2	22				56	16	40	78.4
	2-4	23							
	4-6	26	99.0		1.78 (3)				
	6-8	23				58	18	40	75.0
	8-10	18							
	10-12	15	118.5		2.30 (7)				
	12-14	16				36	14	22	62.0
B-66	0-2	20							
	2-4	25	99.2	1.24					
	4-6	21				56	17	39	81.1
	6-8	20							
	8-10	24	101.1		1.27 (6)				
	10-12	16				29	13	16	62.8
	12-14	15							
	14-15	17	113.8		2.46 (10)				
B-67	0-2	21	107.9	2.33					
	2-4	17				51	16	35	64.2
	4-6	22							
	6-8	17							
	8-10	17	113.3		2.33 (6)				
	10-12	14				38	14	24	63.6
	12-13	15							
B-68	0-2	18							
	2-4	15	109.8	4.19					
	4-6	18							
	6-8	19				68	19	49	84.7
	8-10	25	102.1		1.70 (6)				
	10-12	23							

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-69	0-2	19	107.1	2.56					
	2-4	19				59	17	42	80.6
	4-6	21							
	6-8	20	107.7		1.83 (5)				
	8-10	16				29	11	18	62.8
	10-12	15							
	12-14	14	120.9		3.15 (9)				
	14-16	16				23	16	7	44.4
	16-18	17							
	18-20	20							
	22-24	23							
B-70	0-2	21	106.9	1.69					
	2-4	15				49	14	35	73.9
	4-6	18							
	6-8	18							
	8-10	16	117.4		3.26 (6)				
	10-12	14				34	12	22	58.3
B-71	0-2	16							
	2-4	17				48	15	33	70.6
	4-6	19	109.7		2.88 (3)				
	6-8	19							
	8-10	14							
	10-12	13	127.1		5.29 (7)				
	12-13	14				31	12	19	36.6
B-72	0-2	23							
	2-4	21	108.3	1.60					
	4-6	14				43	16	27	57.4
	6-8	24							
	8-10	15	115.6		1.67 (6)				
	10-12	12				29	13	16	45.5
	12-14	15	118.1		2.18 (7)				
	14-16	19							
	16-18	20							9.5
	18-20	20							
	22-24	20							

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-73	0-2	22							
	2-4	19	108.2	1.39					
	4-6	19							
	6-8	20				48	16	32	85.5
	8-10	15							
	10-12	15	119.0		3.27 (7)				
	12-13	14							
B-74	0-2	20							
	2-4	21	107.8	1.59					
	4-6	21				49	14	35	72.3
	6-8	25							
	8-10	17							
	10-12	17	116.3		3.11 (7)				
	12-13	15				29	19	10	31.8
B-75	0-2	28							
	2-4	23				57	17	40	80.8
	4-6	21	109.5		1.86 (3)				
	6-8	18							
	8-10	15				29	14	15	53.8
	10-12	14	118.9		3.01 (7)				
B-76	0-2	15							
	2-4	16							
	4-6	19	111.2		2.45 (3)				
	6-8	18				41	14	27	56.3
	8-10	18							
	10-12	15							
B-77	0-2	16				38	14	24	76.9
	2-4	17							
	4-6	20	111.7		2.59 (3)				
	6-8	16				36	12	24	56.4
	8-10	16							
	10-12	15	118.3		3.35 (7)				
	12-14	17				37	15	22	49.4
	14-16	19							

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-78	0-2	21							
	2-4	17				45	15	30	77.0
	4-6	16	114.9		2.66 (3)				
	6-8	23							
	8-10	16							
	10-12	15				31	12	19	57.2
	12-13	14	120.7		2.96 (8)				
B-79	0-2	23							
	2-4	20	114.9	2.35					
	4-6	21							
	6-8	18				50	16	34	71.9
	8-10	27							
	10-12	25	99.4		3.02 (7)				
	12-13	29							
B-80	0-2	22							
	2-4	21				57	17	40	84.7
	4-6	22	106.5		1.94 (3)				
	6-8	20							
	8-10	36							
	10-12	15	118.2		2.67 (7)				
	12-13	16				33	13	20	49.9
B-81	0-2	24	102.4	1.74					
	2-4	25							
	4-6	23				58	17	41	70.7
	6-8	20							
	8-10	32	92.4		1.02 (6)				
	10-12	31							
	12-14	19				29	13	16	55.1

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-82	0-2	23				61	18	43	89.3
	2-4	21	107.6	2.71					
	4-6	17							
	6-8	14				47	17	30	53.4
	8-10	22	106.6		2.14 (6)				
	10-12	28							
	12-14	30							
	14-16	27				55	21	34	96.7
	16-18	28	94.9		1.93 (11)				
B-83	0-2	17							
	2-4	19				45	14	31	79.3
	4-6	21	101.7		0.88 (3)				
	6-8	16							
	8-10	22							
	10-12	23	106.8		1.61 (7)				
	12-14	24				43	18	25	99.9
	14-15	23							
B-84	0-2	20							
	2-4	15	115.5	2.39					
	4-6	17				40	14	26	51.1
	6-8	20							
	8-10	15							
	10-12	18	115.2		1.44 (7)				
	12-14	14				28	16	12	39.1
	14-15	16							
B-85	0-2	17				34	13	21	75.4
	2-4	17							
	4-6	18	111.9		3.04 (3)				
	6-8	18							
	8-10	23				29	13	16	42.5
	10-12	16							
	12-14	14	120.4		2.91 (9)				
	14-16	14				35	13	22	40.2
	16-17	14							

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-86	0-2	15				35	15	20	65.1
	2-4	12							
	4-6	9	123.4		2.19 (3)				
	6-8	16				36	15	21	47.9
	8-10	16							
	10-12	23	101.9		1.08 (7)				
	12-14	19				np	np	np	44.5
B-87	0-2	15							
	2-4	17	111.3	1.80					
	4-6	18				38	15	23	73.0
	6-8	21							
	8-10	29							
	10-12	22	106.0		1.89 (7)				
	12-13	23				56	23	33	98.5
B-88	0-2	21	108.2	2.48					
	2-4	21							
	4-6	19				48	15	33	82.9
	6-8	20							
	8-10	26	100.2		1.69 (6)				
	10-12	26							
B-89	0-2	12	116.6	4.04					
	2-4	10				34	13	21	64.7
	4-6	9							
	6-8	16							
	8-10	16	113.6		7.46 (6)				
	10-12	19				62	25	37	98.4
	12-13	20							
B-90	0-2	17	111.8	1.93					
	2-4	15				42	14	28	62.2
	4-6	18							
	6-8	17	111.3		2.04 (5)				
	8-10	17							
	10-12	15							
	12-14	15				36	14	22	36.7
	14-15	18	115.5		1.52 (9)				

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-91	0-2	14							
	2-4	12							
	4-6	13							
	6-8	18							
	8-10	15							
	10-12	15							
	12-14	14							
B-92	0-2	17							
	2-4	14	114.0	6.26					
	4-6	15				46	16	30	87.1
	6-8	15							
	8-10	18							
	10-12	17	104.9		2.82 (7)				
	12-13	20				42	19	23	99.8
B-93	0-2	19				52	15	37	60.7
	2-4	21							
	4-6	22	104.9		0.69 (3)				
	6-8	19				33	16	17	87.5
	8-10	23							
	10-12	25							
	12-14	25	101.6		2.96 (9)				
	14-15	26				62	24	38	99.7
B-94	0-2	17							
	2-4	16	113.0	2.37		43	15	28	73.7
	4-6	18							
	6-8	16	115.6		4.33 (5)				
	8-10	21							
	10-12	18	99.2		0.72 (7)	28	20	8	68.1
	12-14	24							25.4

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-95	0-2	17	112.0	3.02					
	2-4	15				46	16	30	83.4
	4-6	15							
	6-8	21							
	8-10	18	107.1		0.96 (6)				
	10-12	17				33	14	19	55.9
	12-14	16							
	14-15	15							
B-96	0-2	19				39	13	26	81.3
	2-4	19							
	4-6	19	107.8		1.48 (3)				
	6-8	19							
	8-10	16				44	14	30	65.7
	10-12	15	117.6		2.94 (7)				
	12-14	14							
B-97	0-2	20				42	15	27	80.5
	2-4	15							
	4-6	16							
	6-8	17	108.0		1.99 (5)				
	8-10	16				44	14	30	64.9
	10-12	14							
	12-14	15							
	14-16	16	116.4		3.06 (9)				
	16-17	14				47	15	32	50.7
B-98	0-2	15							
	2-4	15				53	17	36	84.1
	4-6	16	113.2		7.48 (3)				
	6-8	18							
	8-10	23							
	10-12	22				35	14	21	65.7
	12-14	20	109.0		2.14 (9)				

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH	WATER CONTENT (%)	DRY DENSITY (pcf)	SHEAR STRENGTH (tsf)		ATTERBERG LIMITS			PERCENT PASSING NO. 200 (%)
				UNCONFINED COMPRESSION TEST	UU TEST (confining pressure in psi)	LL (%)	PL (%)	PI (%)	
B-99	0-2	23							
	2-4	22	103.3	1.45					
	4-6	23				57	16	41	86.0
	6-8	27							
	8-10	17							
	10-12	14	121.0		3.42 (7)				
	12-14	16				38	13	25	75.8
	14-15	15							

AVLES
ENGINEERING CORP.

APPENDIX B

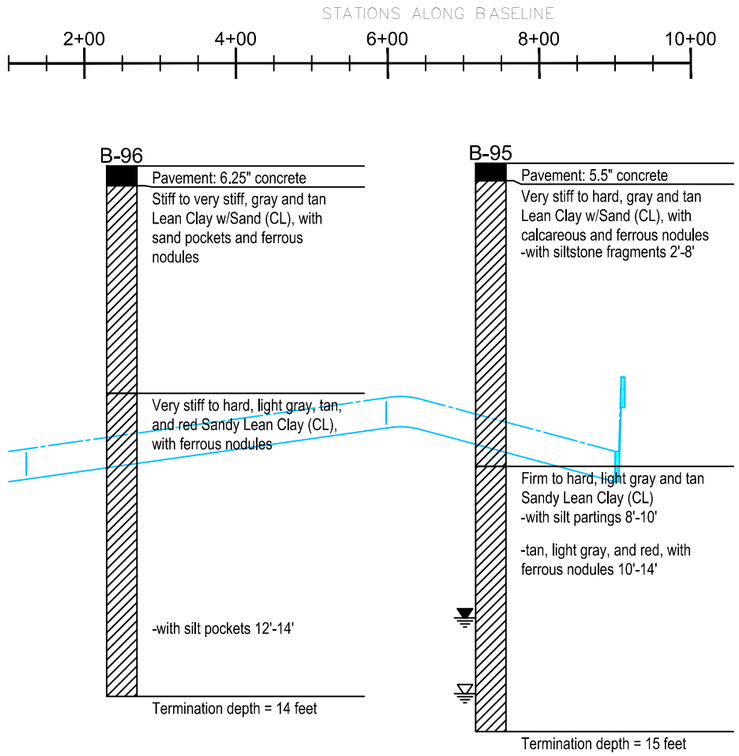
Plates B-1 to B-17 Generalized Soil Profiles

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG DIAGONAL A-A'

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 A-A'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

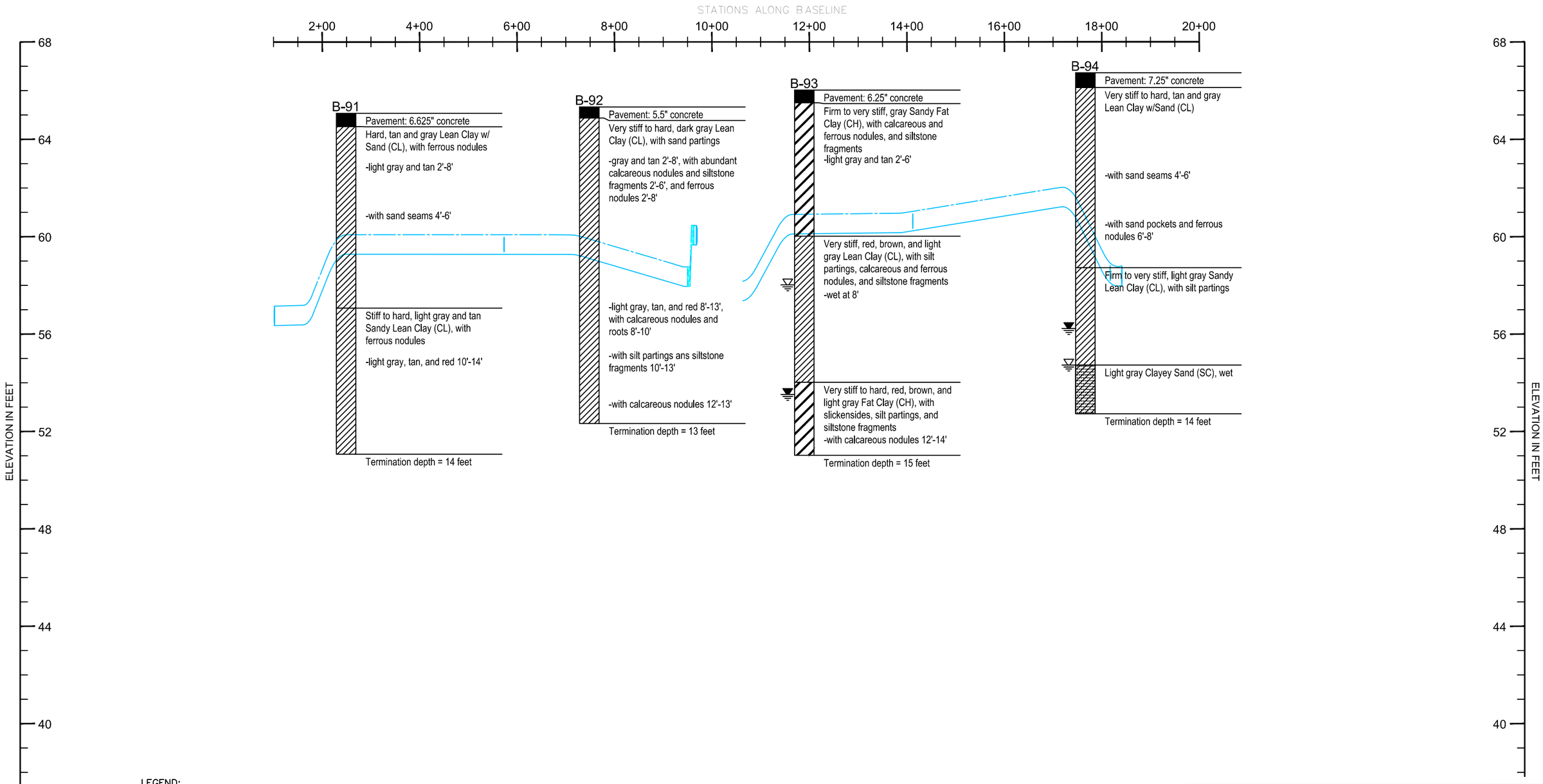
AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-1

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □AS□□ OO□

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 B-B'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-2

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □E MOSS

WEST

EAST

STATIONS ALONG BASELINE

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

68 64 60 56 52 48 44 40 36 32

B-90

Pavement: 5.5" concrete

Stiff to hard, tan and gray Sandy Lean Clay (CL), with ferrous nodules
-with silt pockets 0'-2'
-with siltstone fragments and calcareous nodules 2'-6'

-gray, tan, and red 4'-6'

-tan and gray 6'-8'

Tan, red, and light gray Clayey Sand (SC), with silt partings

Termination depth = 15 feet

B-89

Pavement: 6.25" concrete

Hard, gray Sandy Lean Clay (CL), with abundant calcareous and ferrous nodules, and siltstone fragments
-light gray and tan 2'-6'

Hard, red, brown, and light gray Fat Clay (CH), with slickensides and calcareous nodules
-with sandy clay seams and ferrous nodules 6'-8'
-with silt pockets 8'-10'

-with abundant silt seams 10'-12'

-with silty clay seams 12'-13'

Termination depth = 13 feet

B-88

Pavement: 7.25" concrete

Very stiff to hard, dark gray Lean Clay w/Sand (CL), with ferrous nodules
-gray and tan 2'-8'

-with siltstone fragments 4'-8'

Stiff to very stiff, red, brown, and light gray Fat Clay (CH), with siltstone fragments
-with calcareous and ferrous nodules 8'-10'
-with silt partings 10'-12'

Termination depth = 12 feet

B-87

Pavement: 6.5" concrete

Base: 7" stabilized gravel

Stiff to very stiff, light gray Lean Clay w/ Sand (CL)
-with abundant siltstone fragments and calcareous nodules 1'-4'
-tan and light gray 2'-4', with ferrous nodules 2'-8'
-tan 4'-6'

-gray and tan, with siltstone fragments 6'-8'

Stiff to hard, red, brown, and light gray Fat Clay (CH), with siltstone fragments and silty clay pockets
-with calcareous nodules 8'-12'

Termination depth = 13 feet

B-86

Pavement: 4" asphalt

Base: 6" stabilized clayey sand, with gravel

Very stiff to hard, dark gray Sandy Lean Clay (CL)
-with abundant calcareous nodules and siltstone fragments 2'-6'
-light gray 4'-6'

Tan and light gray Clayey Sand (SC), with abundant calcareous nodules and siltstone fragments

-with silt partings 8'-12'

Tan Silty Sand (SM), wet

Termination depth = 15 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 C-C'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. : G110-13	DATE : 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-3

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □LARE□ OO□

WEST

EAST

STATIONS ALONG BASELINE

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

68 64 60 56 52 48 44 40 36 32

B-81

Pavement: 6.25" concrete

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with slickensides

-dark gray, tan, and light gray, with calcareous nodules 4'-8', and siltstone fragments 4'-12'

-red, brown, and light gray 8'-12', with silt pockets and ferrous nodules 8'-10'

-with silty clay seams 10'-12'

Very stiff, light gray and tan Sandy Lean Clay (CL), with silt pockets

Termination depth = 14 feet

B-82

Pavement: 6.25" concrete

Very stiff, dark gray Fat Clay (CH), with ferrous nodules

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

Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with abundant calcareous and ferrous nodules, and siltstone fragments

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

-with silty clay seams and siltstone fragments 8'-10'

-with silty clay pockets 10'-12'

-with silt pockets 12'-14'

Termination depth = 18 feet

B-83

Pavement: 7.625" concrete

Fill: very stiff, gray Sandy Lean Clay (CL) with siltstone fragments and calcareous nodules

Firm to very stiff, gray and tan Lean Clay w/Sand (CL), with calcareous and ferrous nodules, and siltstone fragments

Stiff to hard, tan and brown Lean Clay (CL), with slickensides and silt partings

-red, brown, and light gray, with siltstone fragments 10'-15' and calcareous nodules 10'-14'

-with clay pockets 12'-15'

Termination depth = 15 feet

B-84

Pavement: 6.75" concrete

Very stiff to hard, tan and gray Sandy Lean Clay (CL)

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

-tan, light gray, and red 6'-10', with silt partings 6'-12'

Tan and light gray Clayey Sand (SC), with silt partings, wet

Termination depth = 15 feet

B-85

Pavement: 7" asphalt

Base: 4" lime-stabilized clayey sand, with gravel

Very stiff to hard, gray and light gray Lean Clay w/Sand (CL)

-light gray and tan 4'-8', with vertical sand parting 4'-6'

Light gray, tan, and red Clayey Sand (SC)

-with ferrous nodules 10'-14'

Termination depth = 17 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 D-D'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

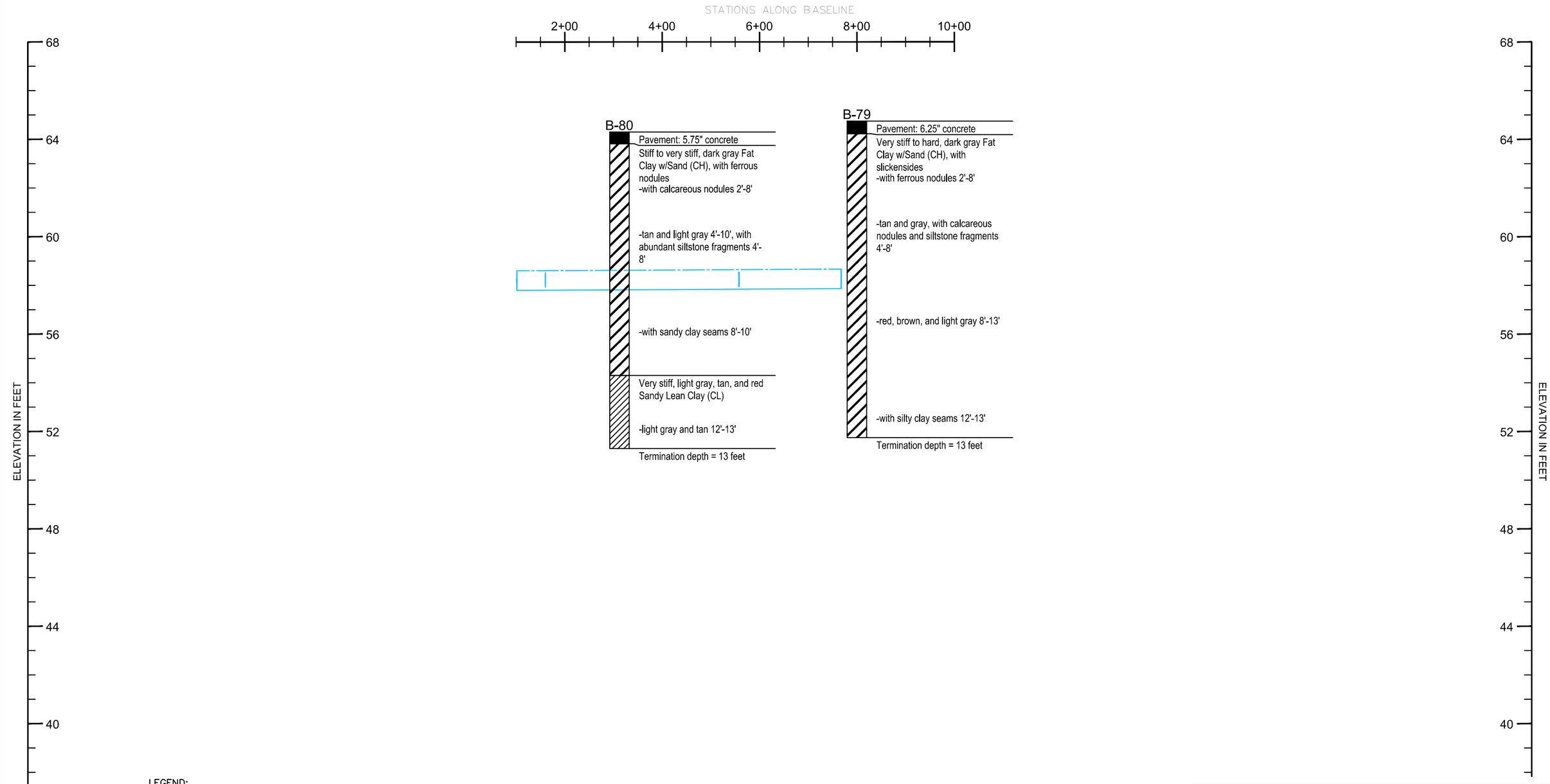
AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-4

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □ORN□ OO□

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 E-E'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

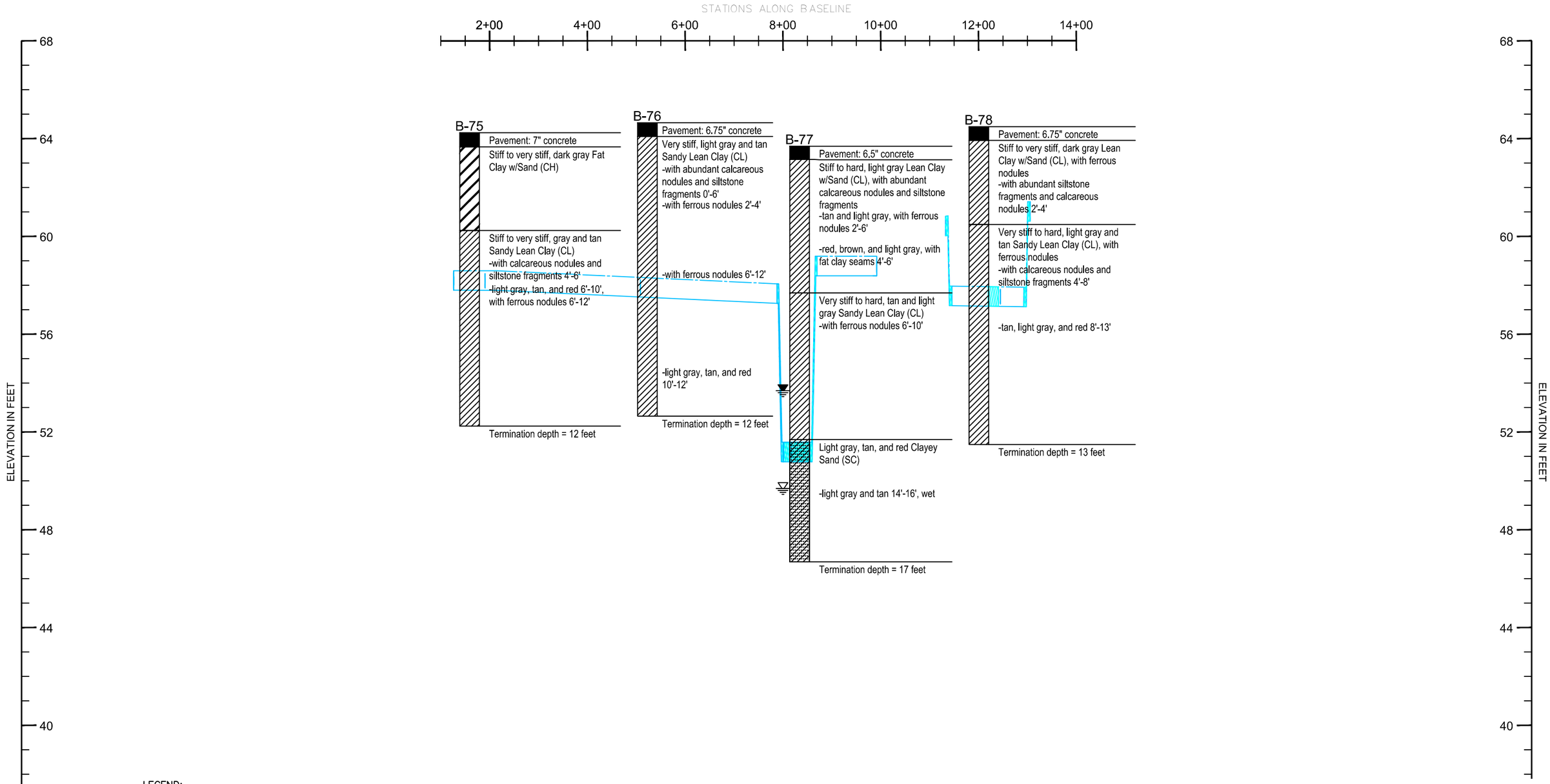
AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-5

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ MOONMIST

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 F-F'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

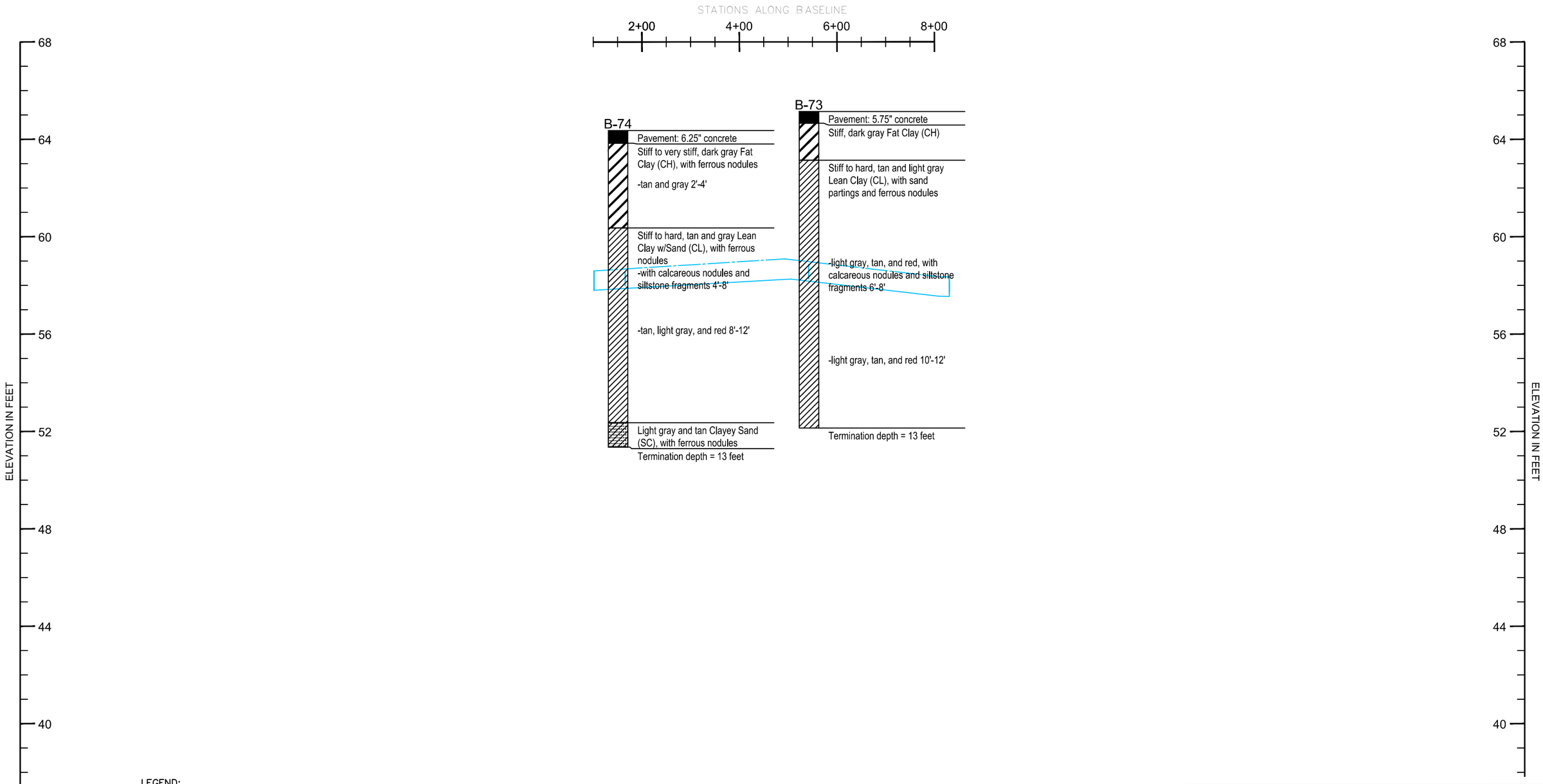
AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' / HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-6

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □/□□ STAR

WEST

EAST



NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 G-G'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

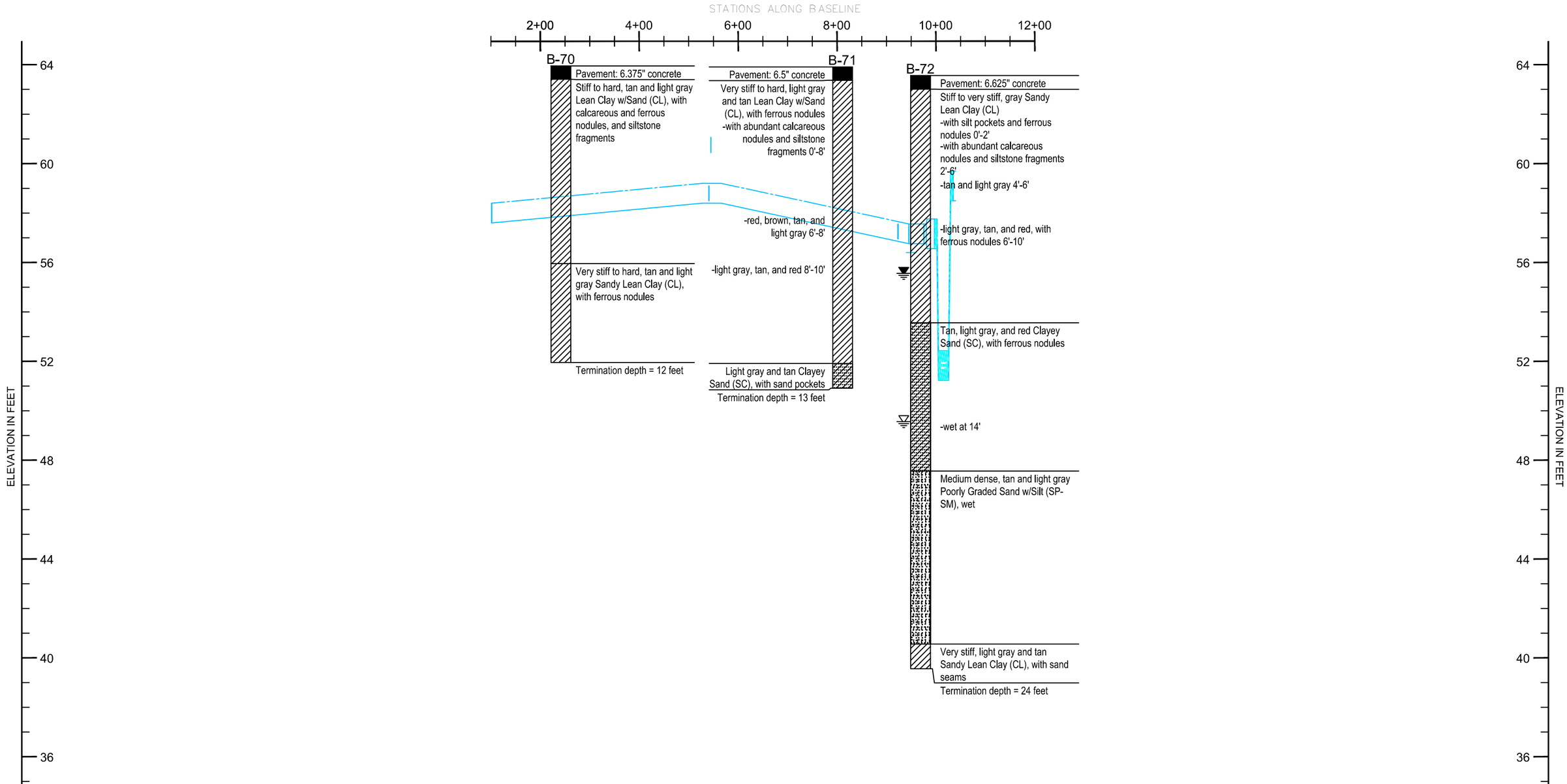
AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-7

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □ELLERI□E

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 H-H'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-8

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG SANDS POINT

WEST

EAST

MATCH LINE STA. 40+00

STATIONS ALONG BASELINE

14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00 30+00 32+00 34+00 36+00 38+00 40+00

ELEVATION IN FEET

68 64 60 56 52 48 44 40 36

B-47

Pavement: 6.875" concrete

Very stiff, gray and tan Lean Clay w/Sand (CL), with siltstone fragments, calcareous and ferrous nodules

Stiff to very stiff, tan and light gray Sandy Lean Clay (CL), with ferrous nodules
-with siltstone fragments and calcareous nodules 4'-8'

-with siltstone fragments and calcareous nodules 10'-13'

Termination depth = 13 feet

B-48

Pavement: 6" concrete

Base: 8" stabilized dark gray clayey sand

Very stiff, dark gray Lean Clay w/ Sand (CL), with siltstone fragments and ferrous nodules
-with fat clay pockets 2'-4'

-gray and tan, with calcareous nodules 4'-6'

Very stiff to hard, tan and light gray Sandy Lean Clay (CL), with ferrous nodules
-with siltstone fragments 6'-8'

-with siltstone fragments 12'-14'

Termination depth = 17 feet

B-49

Pavement: 6.75" concrete

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules

-tan and gray, with calcareous nodules 6'-8'

Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with ferrous nodules
-with silt pockets and calcareous nodules 8'- 10'

Termination depth = 14 feet

B-50

Pavement: 6.5" concrete

Base: 2" stabilized clayey sand

Stiff to very stiff, dark gray Fat Clay (CH)
-with sandy clay seams 0'-2'
-with ferrous nodules 2'-10'

-with siltstone fragments 4'-8'

-gray and tan 6'-10'

-with sandy clay pockets 8'-10'

Stiff to very stiff, light gray and tan Lean Clay w/Sand (CL)
-with silt partings 10'-12'

-with ferrous nodules 12'-14'

Termination depth = 13 feet

B-51

Pavement: 7" concrete

Base: 11" stabilized clayey sand

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules

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

Stiff to hard, tan and light gray Sandy Lean Clay (CL), with slickensides and ferrous nodules
-with siltstone fragments and calcareous nodules 8'-12'

Light gray and tan, Silty Clayey Sand (SC-SM), with silt partings

Termination depth = 15 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 J-J'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-9a

GENERALIZED SUBSURFACE SOIL PROFILE

CONTINUE ALONG SANDS POINT

WEST

EAST

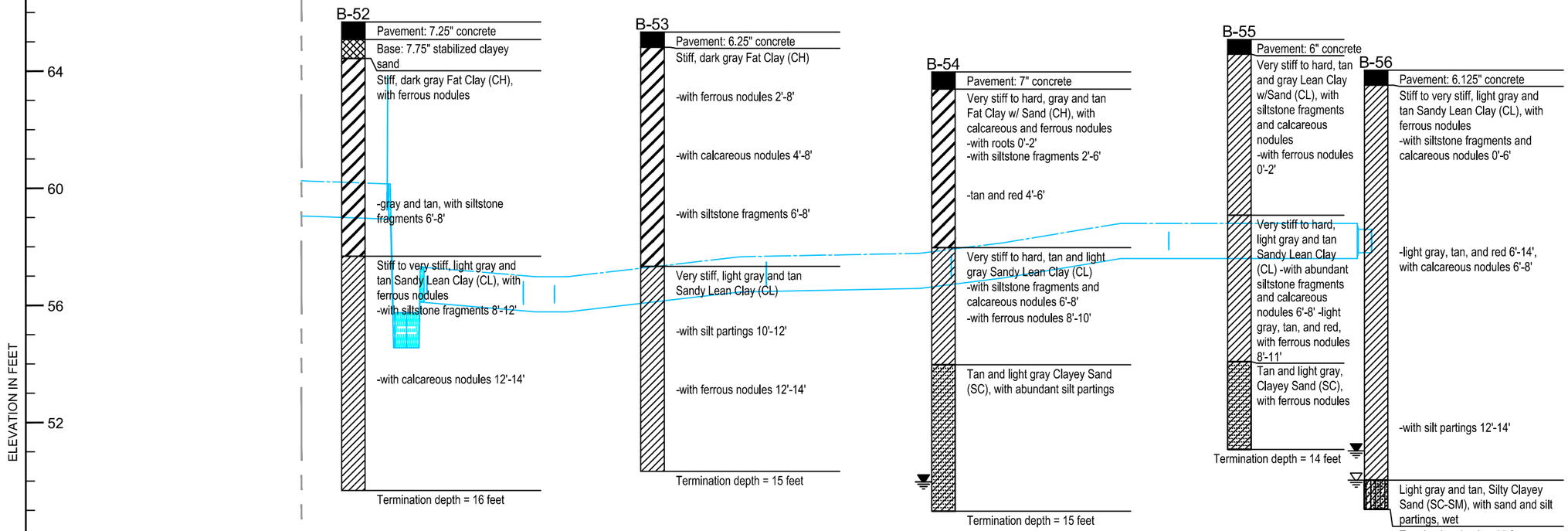
MATCH LINE
STA. 40+00

STATIONS ALONG BASELINE

40+00 42+00 44+00 46+00 48+00 50+00 52+00 54+00 56+00 58+00 60+00

ELEVATION IN FEET

68 64 60 56 52 48 44 40 36



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 J-J'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

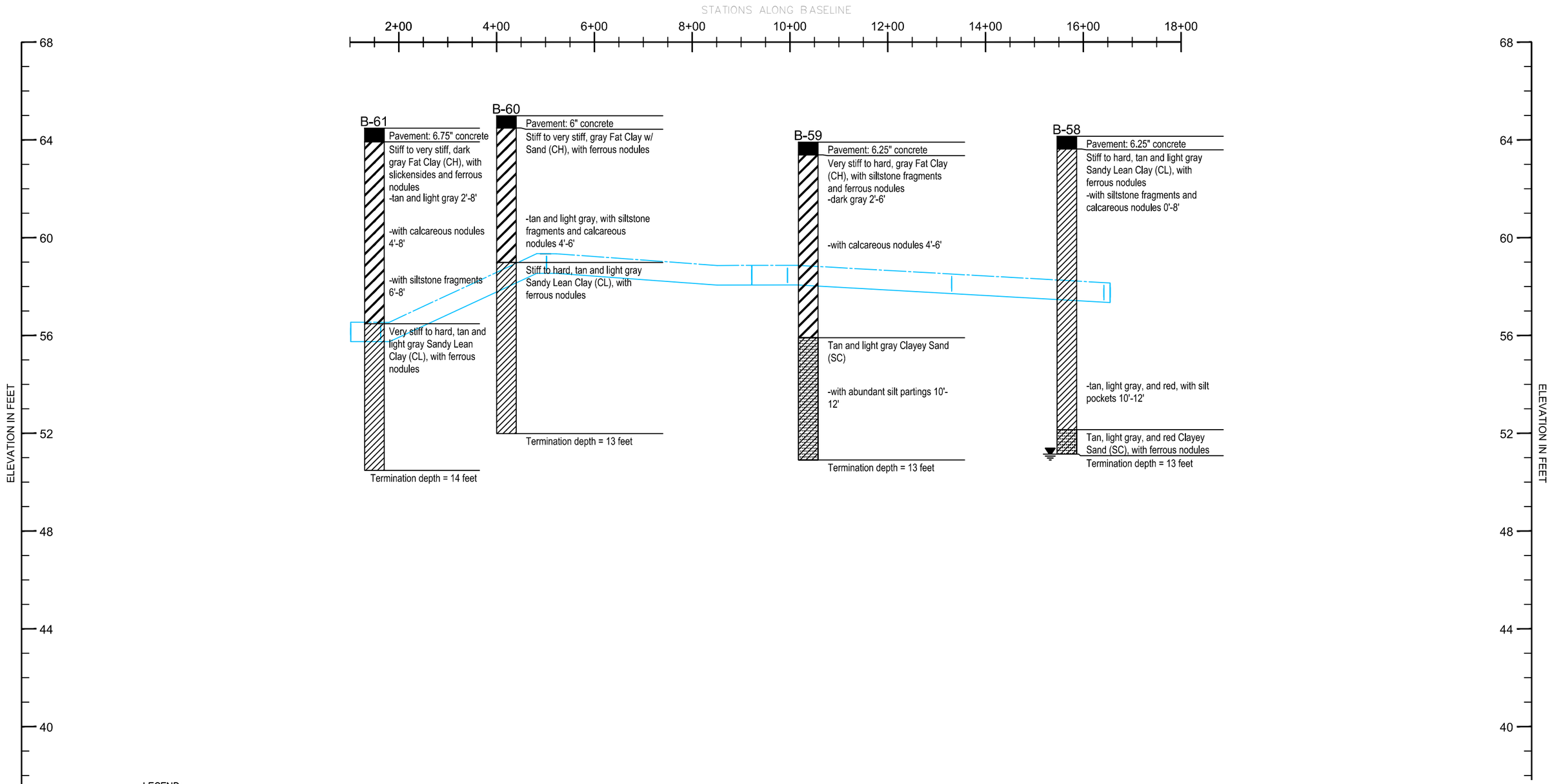
AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-9b

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ □□LFTON

WEST

EAST



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 K-K'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. : G110-13	DATE : 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-10

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ PREST□ OO□

WEST

EAST

STATIONS ALONG BASELINE

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

68 64 60 56 52 48 44 40 36 32

B-62

Pavement: 6.5" concrete

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

-with silt partings 2'-4'

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

Very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules

Termination depth = 13 feet

B-63

Pavement: 6.25" concrete

Stiff to very stiff, gray Fat Clay w/ Sand (CH), with ferrous nodules

-gray and tan 4'-8'

-with calcareous nodules 6'-8'

Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with ferrous nodules

Light gray and tan Clayey Sand (SC)

-with ferrous nodules 12'-14'

-with silt partings 14'-16', wet at 14'

Termination depth = 16 feet

B-64

Pavement: 6.5" concrete

Very stiff, dark gray Lean Clay w/ Sand (CL), with slickensides and ferrous nodules

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with slickensides and ferrous nodules

-gray and tan, with siltstone fragments 6'-8'

Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules

-light gray, tan, and red 10'-14'

Termination depth = 14 feet

B-66

Pavement: 6.5" concrete

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules

-gray 2'-6'

-with siltstone fragments 4'-8'

-tan and gray, with calcareous nodules 6'-8'

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

-with silt partings 8'-12'

Termination depth = 15 feet

B-67

Pavement: 7" concrete

Very stiff to hard, gray and light gray Sandy Fat Clay (CH), with slickensides, abundant calcareous and ferrous nodules, and siltstone fragments

-light gray and tan 2'-6'

Very stiff to hard, tan, light gray, and red Sandy Lean Clay (CL), with ferrous nodules

-with calcareous nodules and siltstone fragments 6'-8'

-with silt partings 8'-10'

Termination depth = 13 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 L-L'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

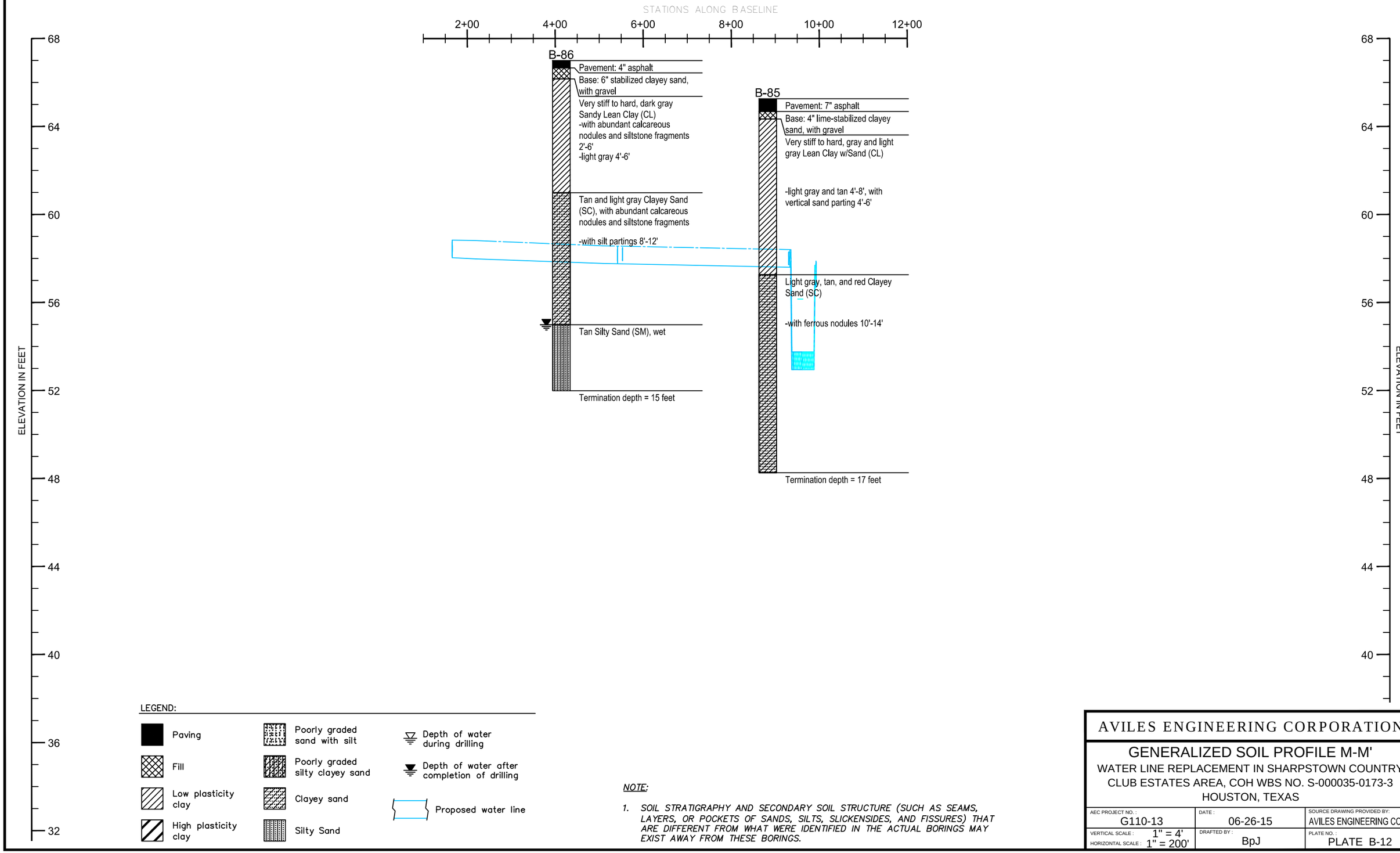
AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-11

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ MARINETTE

SOUTH

NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 M-M'

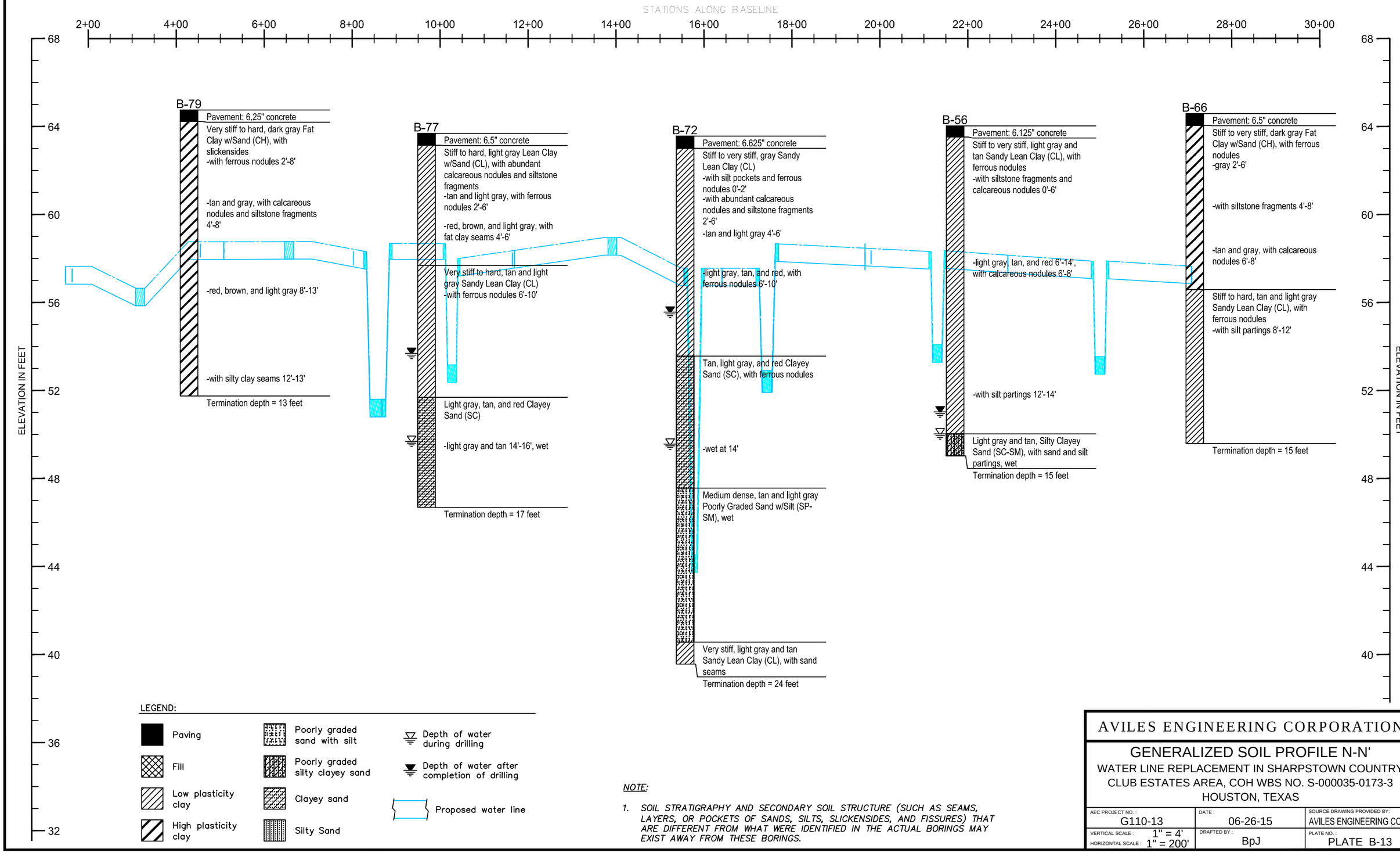
WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' / HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-12

GENERALIZED SUBSURFACE SOIL PROFILE

SOUTH — *ALON□ L□□AR□* — NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 N-N'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO. :	DATE :	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' / HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-13

GENERALIZED SUBSURFACE SOIL PROFILE

ALON TAM O S ANTER Sa d P

SOUTH

NORTH

MATCH LINE
STA. 22+00

STATIONS ALONG BASELINE

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

68 64 60 56 52 48 44 40 36 32

B-97

Pavement: 6.375" concrete

Stiff to very stiff, gray Lean Clay w/Sand (CL)
-with silt pockets 0'-4'
-light gray and tan 2'-6'

-light gray, tan, and red, with sand seams 6'-8'

Very stiff to hard, light gray, tan, and red Sandy Lean Clay (CL)
-with ferrous nodules 8'-14'

Termination depth = 17 feet

B-90

Pavement: 5.5" concrete

Stiff to hard, tan and gray Sandy Lean Clay (CL), with ferrous nodules
-with silt pockets 0'-2'
-with siltstone fragments and calcareous nodules 2'-6'

-gray, tan, and red 4'-6'

-tan and gray 6'-8'

Tan, red, and light gray Clayey Sand (SC), with silt partings

Termination depth = 15 feet

B-81

Pavement: 6.25" concrete

Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with slickensides

-dark gray, tan, and light gray, with calcareous nodules 4'-8', and siltstone fragments 4'-12'

-red, brown, and light gray 8'-12', with silt pockets and ferrous nodules 8'-10'

-with silty clay seams 10'-12'

Very stiff, light gray and tan Sandy Lean Clay (CL), with silt pockets

Termination depth = 14 feet

B-75

Pavement: 7" concrete

Stiff to very stiff, dark gray Fat Clay w/Sand (CH)

Stiff to very stiff, gray and tan Sandy Lean Clay (CL)
-with calcareous nodules and siltstone fragments 4'-6'
-light gray, tan, and red 6'-10', with ferrous nodules 6'-12'

Termination depth = 12 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 P-P'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

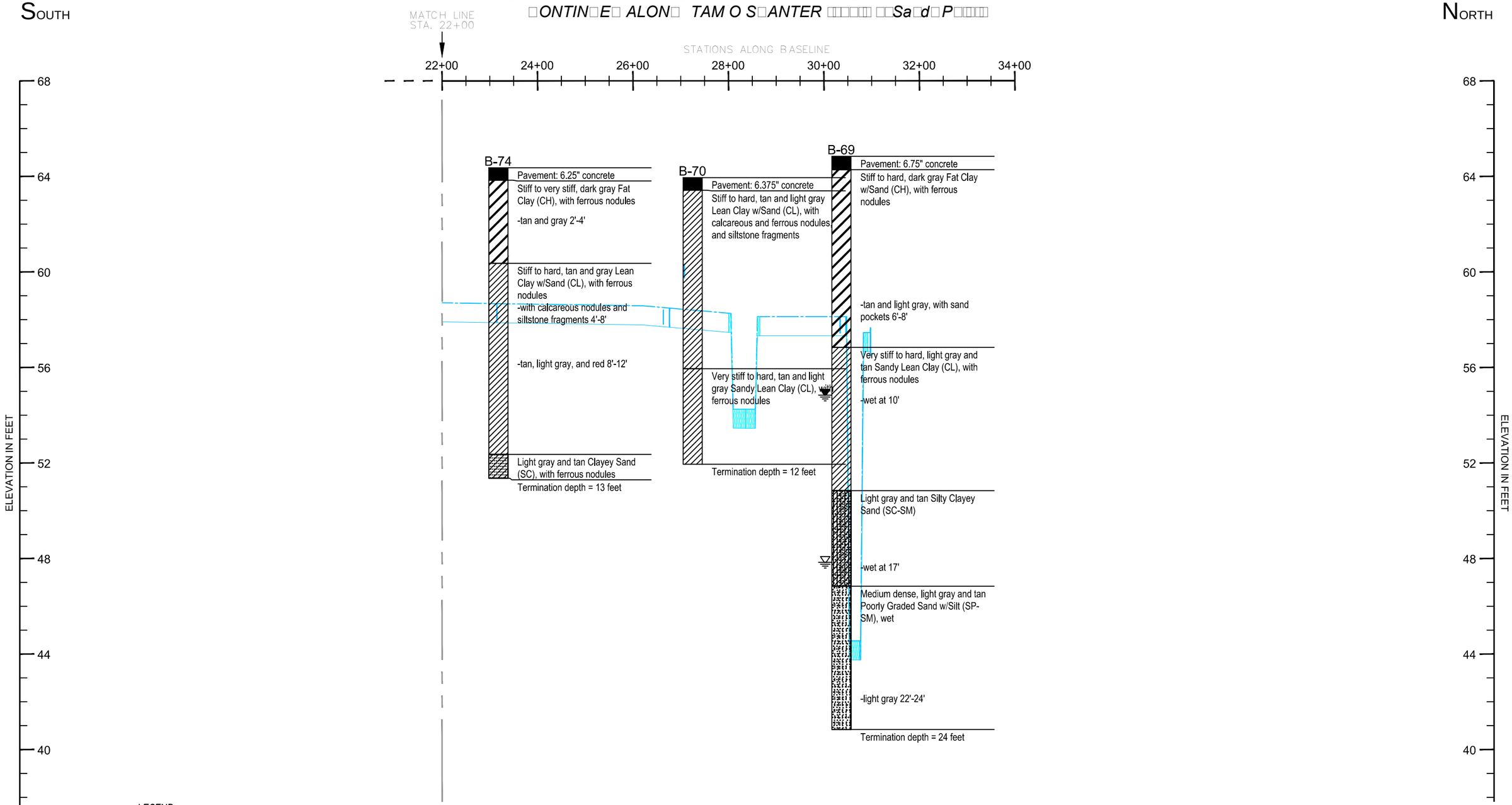
AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G110-13	06-26-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' / HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-14a

GENERALIZED SUBSURFACE SOIL PROFILE

□ONTIN□E□ ALON□ TAM O S□ANTER □□□□□□ □□Sa□d□P□□□□

SOUTH

NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 P-P'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

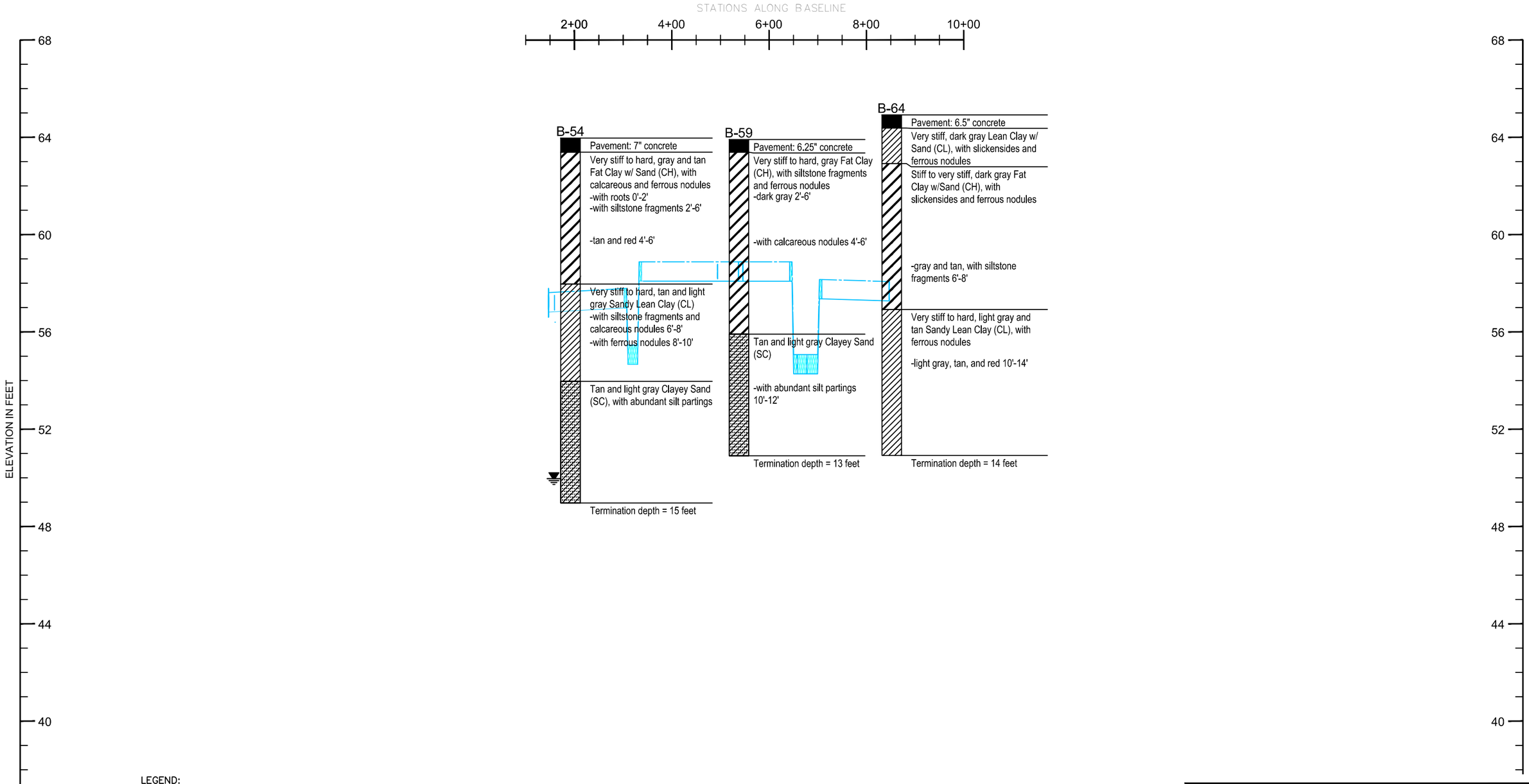
AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-14b

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ TAM O S□ANTER □□□r□□ □□Sa□d□ P□□□□□□

SOUTH

NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 Q-Q'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

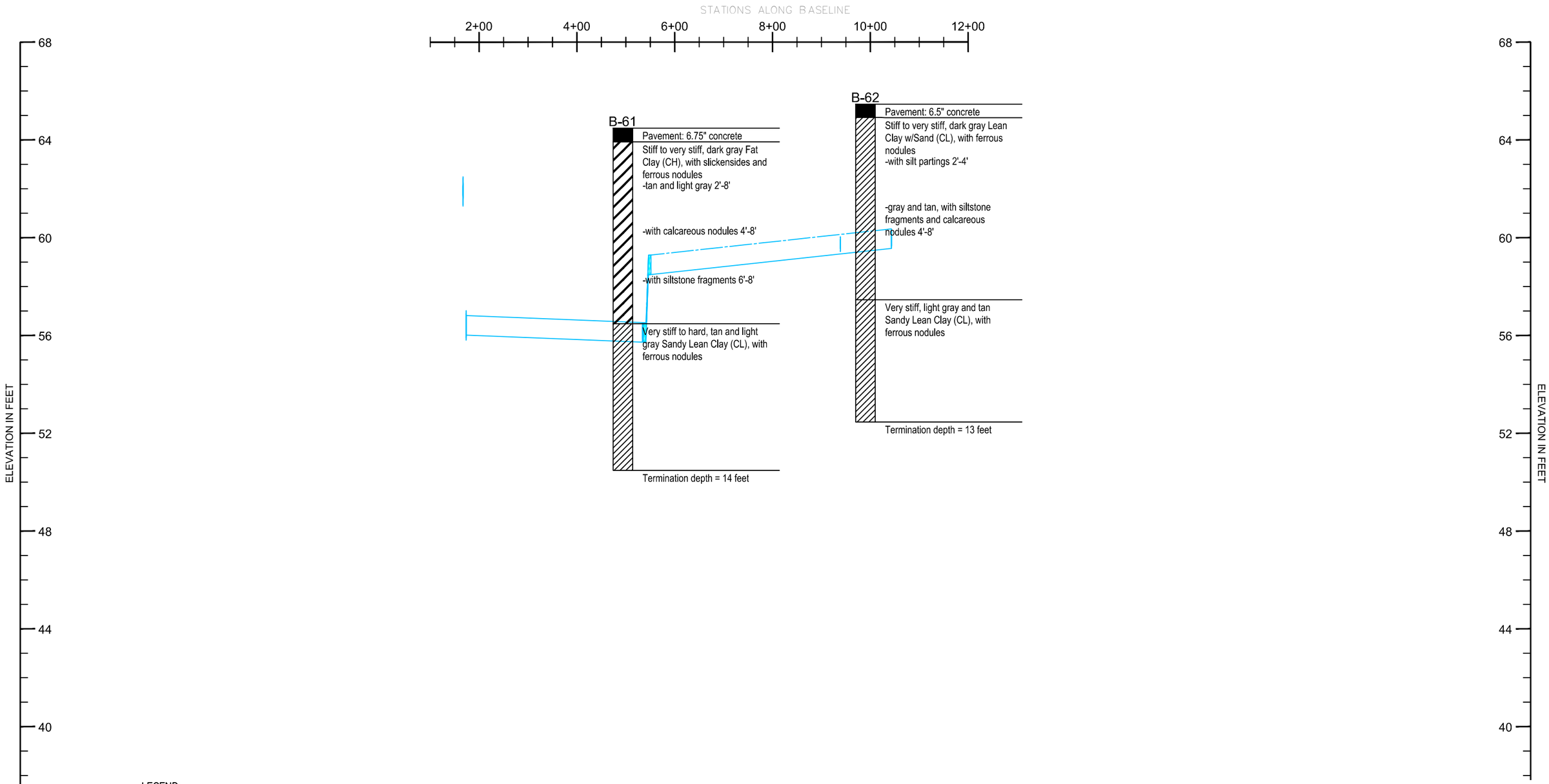
AEC PROJECT NO. : G110-13	DATE : 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-15

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ OSA□E

SOUTH

NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 R-R'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3

HOUSTON, TEXAS

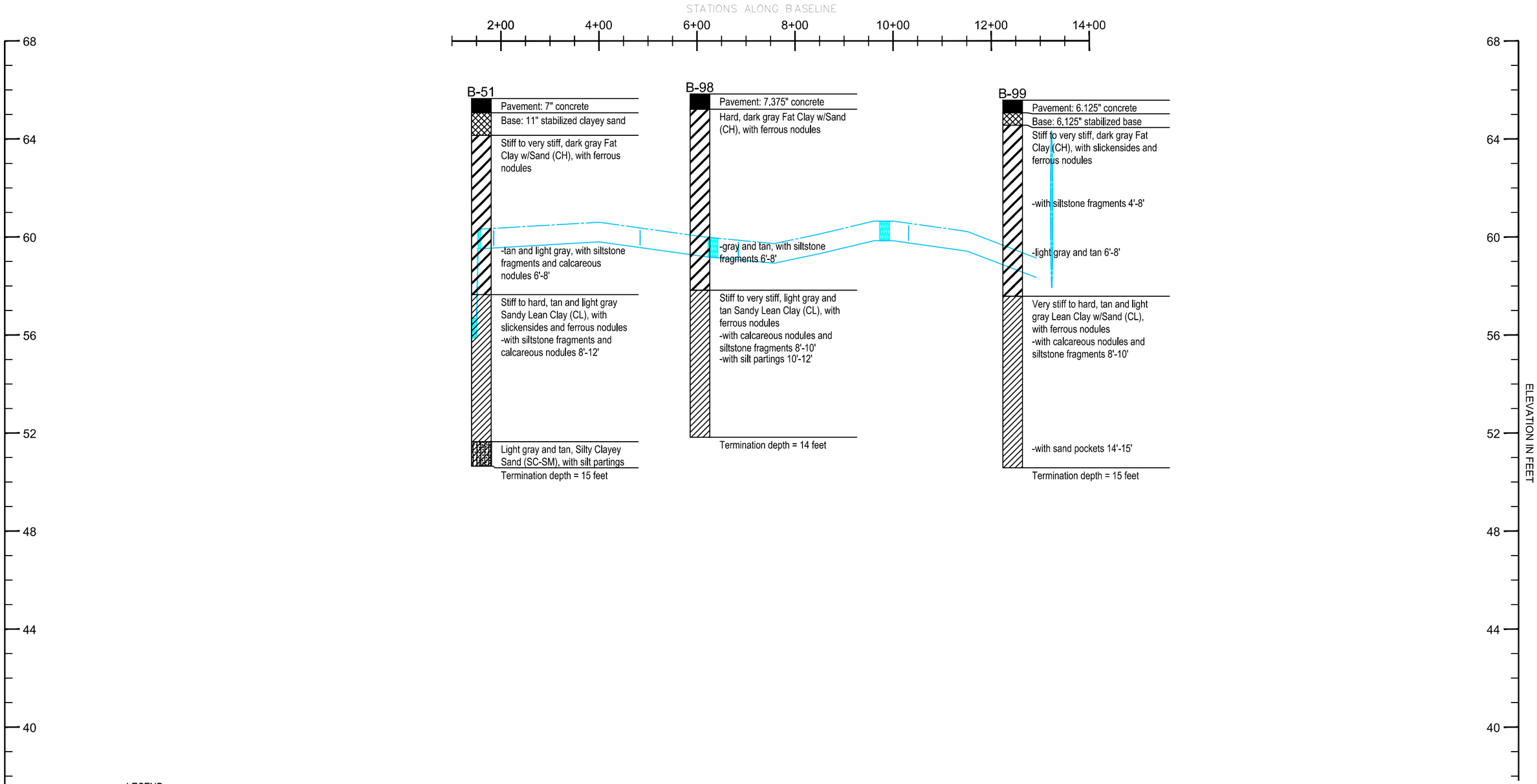
AEC PROJECT NO. : G110-13	DATE : 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE : 1" = 4' HORIZONTAL SCALE : 1" = 200'	DRAFTED BY : BpJ	PLATE NO. : PLATE B-16

GENERALIZED SUBSURFACE SOIL PROFILE

ALON□ ALL□A□

SOUTH

NORTH



LEGEND:

- Paving
- Fill
- Low plasticity clay
- High plasticity clay
- Poorly graded sand with silt
- Poorly graded silty clayey sand
- Clayey sand
- Silty Sand
- Depth of water during drilling
- Depth of water after completion of drilling
- Proposed water line

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, 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 S-S'

WATER LINE REPLACEMENT IN SHARPSTOWN COUNTRY CLUB ESTATES AREA, COH WBS NO. S-000035-0173-3
HOUSTON, TEXAS

AEC PROJECT NO.: G110-13	DATE: 06-26-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-17

AVLES
ENGINEERING CORP.

APPENDIX C

Plates C-1 to C-5	Recommended Geotechnical Design Parameters
Plate C-6	Load Coefficients for Pipe Loading
Plate C-7	Live Loads on Pipe Crossing Under Roadway

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-47	0-8	Stiff to very stiff CL	129	67	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-13	Stiff to very stiff CL	138	76	B	1300	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-48	0-4	Very stiff CL	132	70	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-10	Very stiff CL	132	70	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	10-17	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-49	0-8	Stiff to very stiff CH	127	65	B	1900	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	8-14	Stiff to very stiff CL	136	74	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-50	0-8	Stiff to very stiff CH	125	63	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	8-10	Stiff CH	125	63	B	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	10-13	Stiff to very stiff CL	130	68	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-51	0-8	Stiff to very stiff CH	125	63	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	8-12	Stiff to very stiff CL	123	61	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-14	Hard CL	123	61	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	14-15	SC-SM	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-52	0-8	Stiff CH	122	60	B	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	8-12	Stiff to very stiff CL	131	69	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	12-16	Very stiff to hard CL	133	71	B	2900	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-53	0-8	Stiff CH	126	64	B	1200	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	8-15	Very stiff CL	136	74	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-54	0-6	Very stiff to hard CH	133	71	B	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	6-10	Very stiff to hard CL	125	63	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	10-15	SC	135	73	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-55	0-11	Very stiff to hard CL	133	71	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	11-14	SC	138	76	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-56	0-12	Stiff to very stiff CL	135	73	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-14	Stiff CL	136	74	C*	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	14-15	SC-SM	125	63	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-57	0-6	Stiff to hard CL	134	72	B	1700	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-12	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-58	0-6	Very stiff to hard CL	132	70	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	6-12	Stiff to very stiff CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-13	SC	120	58	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56

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-59	0-8	Very stiff to hard CH	132	70	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
	8-13	SC	136	74	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-60	0-6	Stiff to very stiff CH	127	65	B	1700	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
	6-12	Stiff to hard CL	137	75	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
B-61	0-8	Stiff to very stiff CH	127	65	B	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	8-14	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-62	0-8	Stiff to very stiff CL	122	60	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-12	Stiff to very stiff CL	137	75	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-13	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-63	0-8	Stiff to very stiff CH	125	63	B	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	8-12	Stiff to very stiff CL	130	68	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-16	SC	120	58	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-64	0-2	Very stiff to hard CL	120	58	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-8	Stiff to very stiff CH	126	64	B	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	8-14	Very stiff to hard CL	136	74	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-65	0-8	Stiff to very stiff CH	125	63	B	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	8-14	Very stiff to hard CL	137	75	B	2300	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-66	0-8	Stiff to very stiff CH	124	62	B	1200	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	8-10	Stiff to very stiff CL	125	63	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	10-15	Very stiff to hard CL	133	71	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-67	0-6	Very stiff to hard CH	131	69	B	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	6-10	Very stiff CL	132	70	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-13	Very stiff to hard CL	132	70	B	2500	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
B-68	0-8	Hard CH	127	65	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
	8-12	Stiff to very stiff CH	128	66	B	1700	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
B-69	0-6	Very stiff to hard CH	127	65	B	2600	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
	6-8	Stiff to very stiff CH	130	68	B	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	8-10	Very stiff CL	138	76	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-14	Very stiff to hard CL	138	76	C*	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	14-24	Medium dense SC-SM/SP-SM	120	58	C (14-20)	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00

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-70	0-8	Stiff to hard CL	130	68	B	1700	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-12	Very stiff to hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-71	0-8	Very stiff CL	131	69	B	2600	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	8-12	Hard CL	144	82	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	12-13	SC	120	58	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-72	0-8	Stiff to very stiff CL	131	69	B	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-10	Stiff CL	133	71	C*	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	10-14	SC	136	74	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
	14-24	Medium dense SC/SP-SM/CL	120	58	C (14-20)	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-73	0-2	Stiff CH	120	58	B	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	2-8	Stiff to very stiff CL	129	67	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	8-13	Very stiff to hard CL	137	75	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-74	0-4	Stiff to very stiff CH	131	69	B	1600	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
	4-8	Stiff CL	136	74	B	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	8-12	Very stiff to hard CL	136	74	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	12-13	SC	120	58	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-75	0-4	Stiff to very stiff CH	120	58	B	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	4-8	Stiff to very stiff CL	133	71	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	8-12	Very stiff CL	136	74	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-76	0-12	Very stiff CL	132	70	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
B-77	0-2	Stiff CL	134	72	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	2-10	Very stiff to hard CL	134	72	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
	10-12	Very stiff to hard CL	136	74	C*	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	12-17	SC	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-78	0-4	Stiff to very stiff CL	133	71	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	4-10	Very stiff CL	133	71	B	2600	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	10-13	Very stiff to hard CL	138	76	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-79	0-8	Very stiff CH	138	76	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	8-13	Very stiff to hard CH	124	62	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-80	0-10	Stiff to very stiff CH	131	69	B	1900	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	10-13	Very stiff CL	136	74	B	2600	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89

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-81	0-8	Stiff to very stiff CH	127	65	B	1700	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
	8-12	Stiff to very stiff CH	121	59	B	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
	12-14	Very stiff CL	120	58	C*	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-82	0-4	Very stiff CH	131	69	B	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	4-8	Very stiff to hard CL	120	58	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-12	Very stiff CH	131	69	B	2100	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	12-18	Stiff to very stiff CH	122	60	B	1900	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
B-83	0-2	Fill: very stiff CL	120	58	C	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-6	Firm to very stiff CL	123	61	B	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	6-8	Very stiff CL	123	61	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-12	Stiff CL	132	70	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	12-15	Very stiff to hard CL	132	70	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-84	0-8	Very stiff to hard CL	133	71	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
	8-10	Stiff to very stiff CL	136	74	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	10-12	Stiff CL	136	74	C*	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-15	SC	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-85	0-2	Very stiff CL	132	70	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	2-8	Very stiff to hard CL	137	75	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-10	SC	137	75	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	10-17	SC	137	75	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-86	0-6	Very stiff to hard CL	134	72	B	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-12	SC	126	64	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
	12-15	SM	120	58	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-87	0-6	Stiff to very stiff CL	130	68	B	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	6-8	Stiff CL	130	68	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	8-10	Stiff CH	129	67	C*	1700	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
	10-13	Stiff to hard CH	129	67	C	1900	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
B-88	0-8	Very stiff to hard CL	131	69	B	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
	8-12	Stiff to very stiff CH	126	64	C*	1700	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
B-89	0-6	Hard CL	131	69	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	6-13	Hard CH	132	70	B	3000	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-90	0-8	Stiff to hard CL	130	68	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-15	SC	137	75	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77

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-91	0-8	Hard CL	131	69	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-10	Very stiff CL	132	70	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-14	Hard CL	132	70	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-92	0-10	Hard CL	130	68	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	10-13	Very stiff CL	123	61	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-93	0-2	Very stiff CH	128	66	B	1500	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
	2-6	Firm to very stiff CH	128	66	B	700	0	1.00	1.00	1.00	50	16	0.57	0.72	1.76
	6-8	Very stiff CL	120	58	B	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-12	Very stiff CL	120	58	C*	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	12-15	Very stiff to hard CH	128	66	C*	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-94	0-8	Very stiff to hard CL	131	69	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	8-10	Very stiff CL	117	55	B	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	10-12	Firm to stiff CL	117	55	C*	700	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
	12-14	SC	115	53	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-95	0-8	Very stiff to hard CL	131	69	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-12	Firm to very stiff CL	126	64	B	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-15	Very stiff to hard CL	126	64	C*	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-96	0-6	Stiff to very stiff CL	129	67	B	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	6-14	Very stiff to hard CL	136	74	B	2900	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-97	0-8	Stiff to very stiff CL	126	64	B	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-13	Hard CL	135	73	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	13-17	Very stiff to hard CL	135	73	C*	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-98	0-8	Hard CH	131	69	B	3000	300	13.93	1.87	0.07	300	16	0.57	0.72	1.76
	8-14	Stiff to very stiff CL	131	69	B	1800	200	2.04	1.34	0.49	175	18	0.53	0.69	1.89
B-99	0-8	Stiff to very stiff CH	126	64	B	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	8-15	Very stiff to hard CL	138	76	B	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89

(1) γ = Unit weight for soil above water level, γ′ = Buoyant unit weight for soil below water level. E'n = Soil modulus for native soils;

(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, SC = Clayey Sand; SM = Silty Sand; SP-SM = Poorly Graded Sand with Silt; SC-SM = Silty Clayey Sand

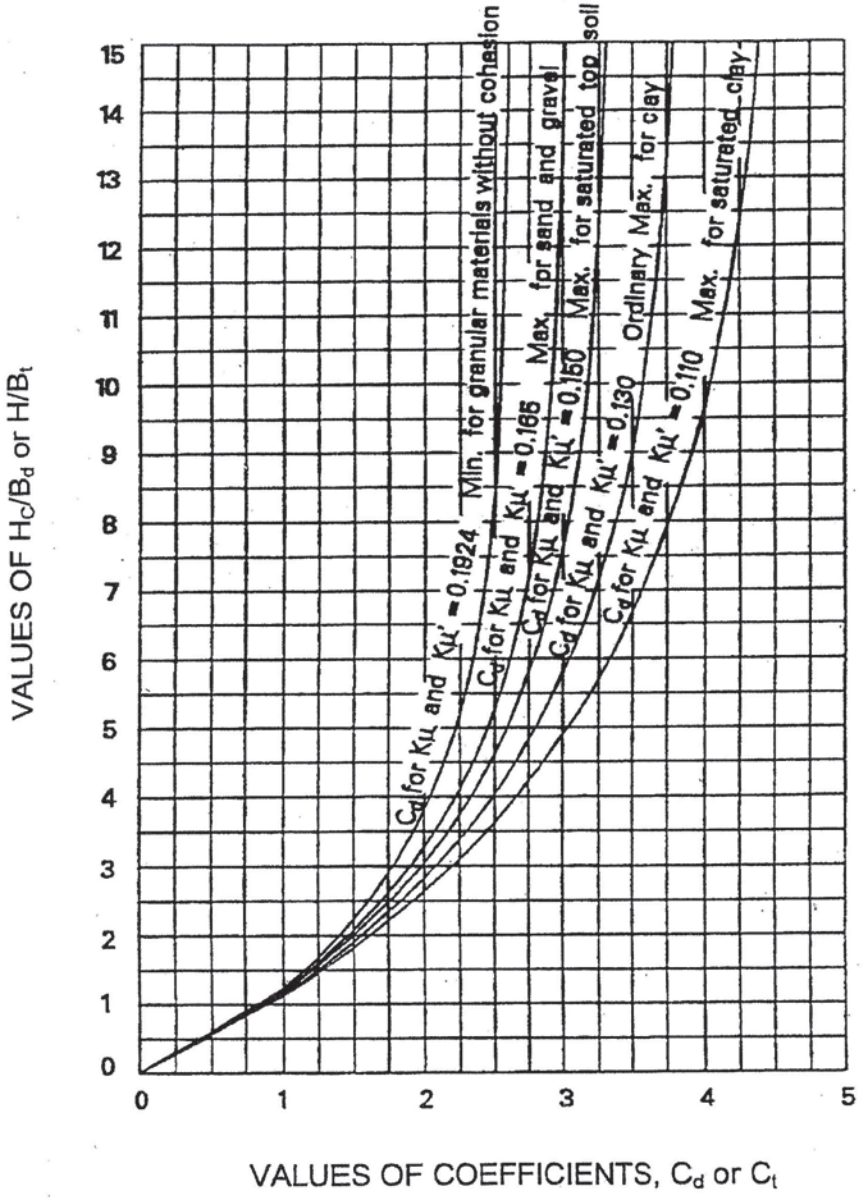
(6) OSHA Soil Types for soils in the top 20 feet below grade:

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

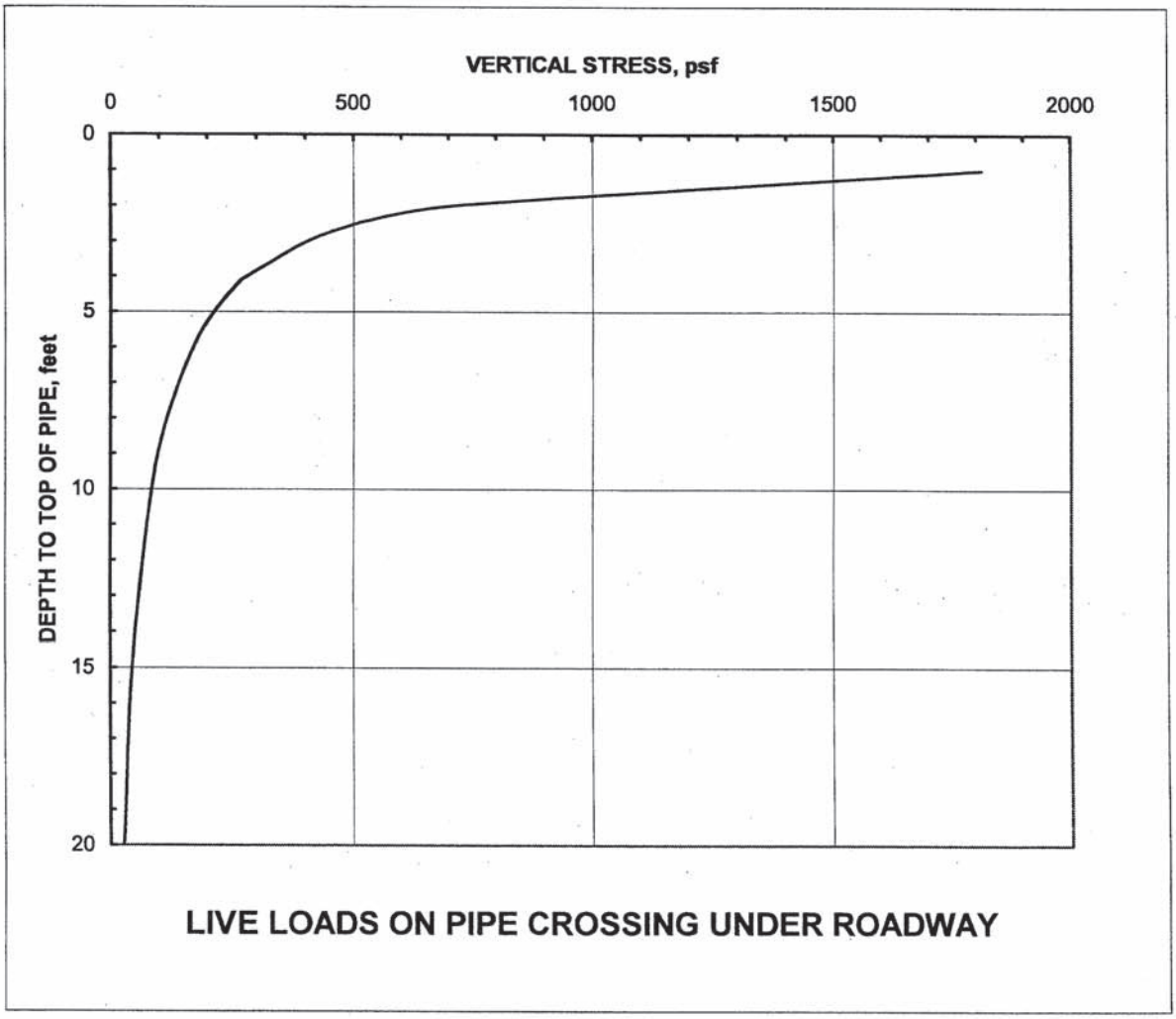
B: cohesive soils with qu = 0.5 tsf or greater

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

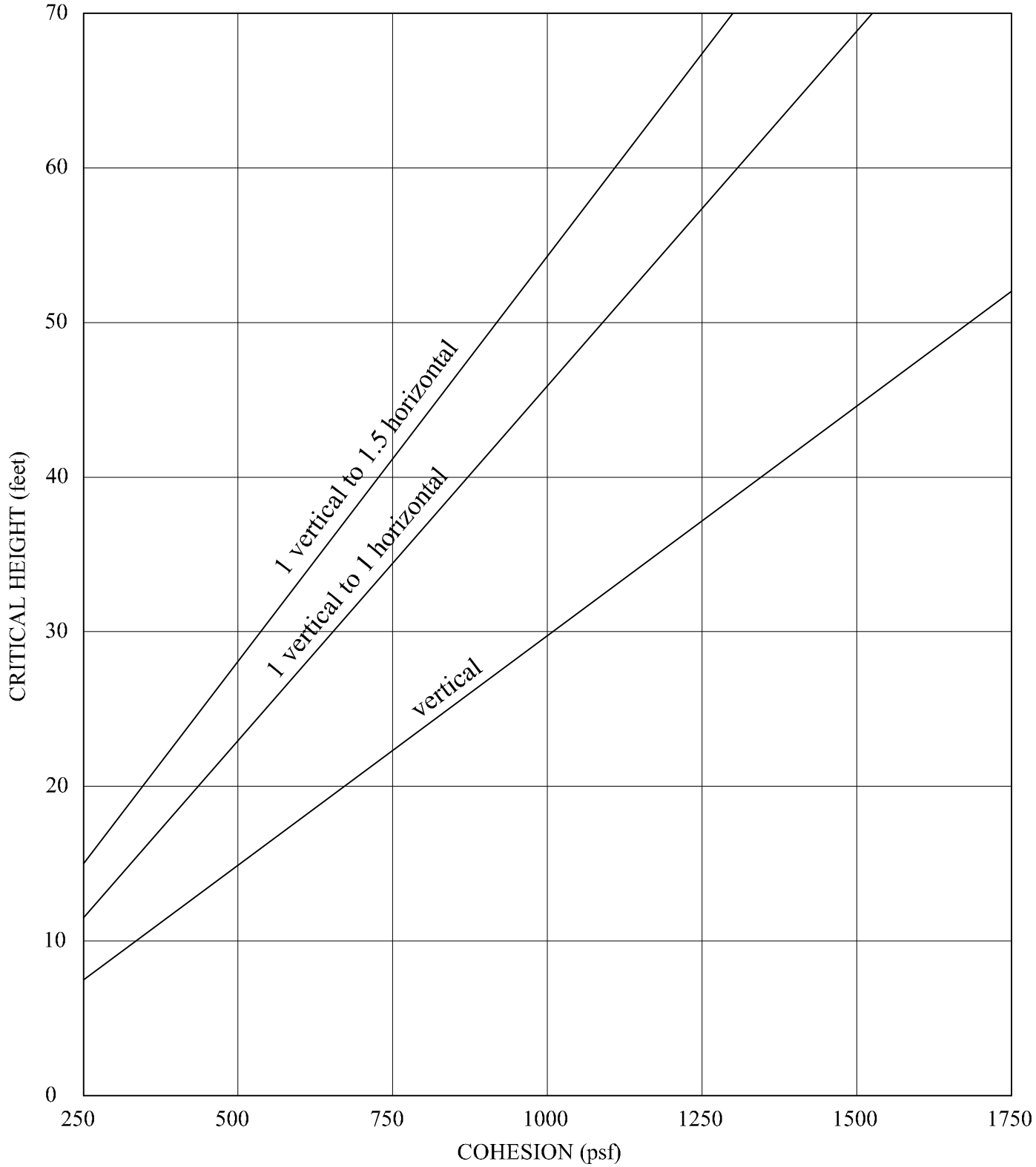
Note: 1. The vertical stress was estimated using AASHTO HS20 truck axle loadings on paved surfaces (Reference: ASCE 15-98, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standandard Installations").
2. Single truck passing.

AVLES
ENGINEERING CORP.

APPENDIX D

AYLES
ENGINEERING CORP.

Critical Heights of Cut Slopes in Nonfissured Clays

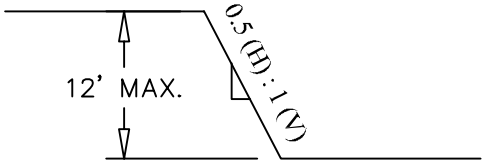
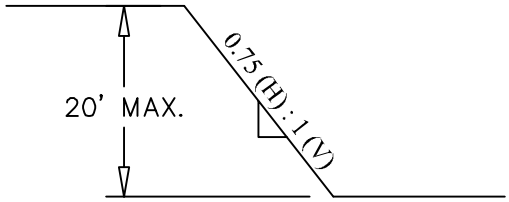
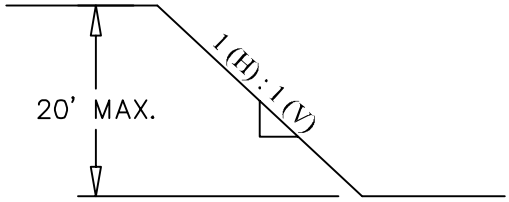
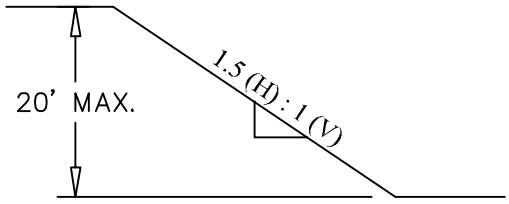


Note: The charts are calculated based on NAVFAC DM7.1, Page 7.1-319, assuming the critical circles are toe circles, and wet unit weight of soils = 125pcf.

PLATE D-1

AYLES
ENGINEERING CORP.

MAXIMUM ALLOWABLE SLOPES

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

NOTES:

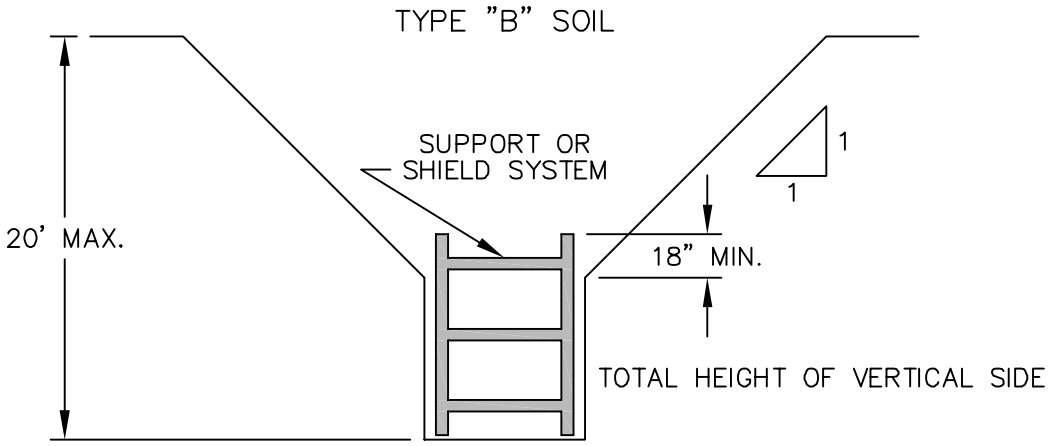
(1) For Type A soils, a short term maximum allowable slope of 0.5 (H) : 1 (V) is allowed in excavations that are 12 feet or less in depth; short term (24 hours or less) maximum allowable slopes for excavations greater than 12 feet in depth shall be 0.75 (H) : 1 (V).

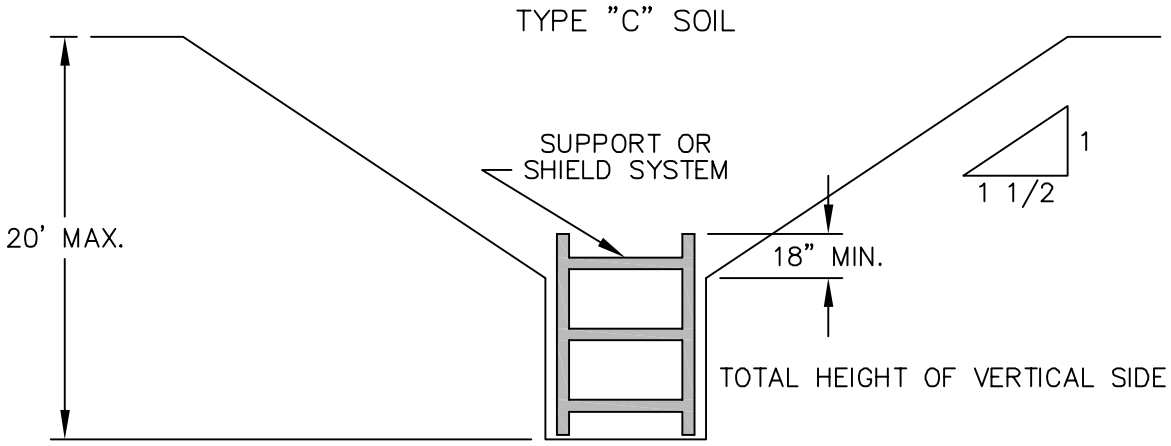
(2) Maximum depth for above slopes is 20 feet. For slopes deeper than 20 feet, trench protection should be designed by the Contractor's professional engineer.

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

AYLES
ENGINEERING CORP.

A COMBINATION OF BRACING AND OPEN CUTS

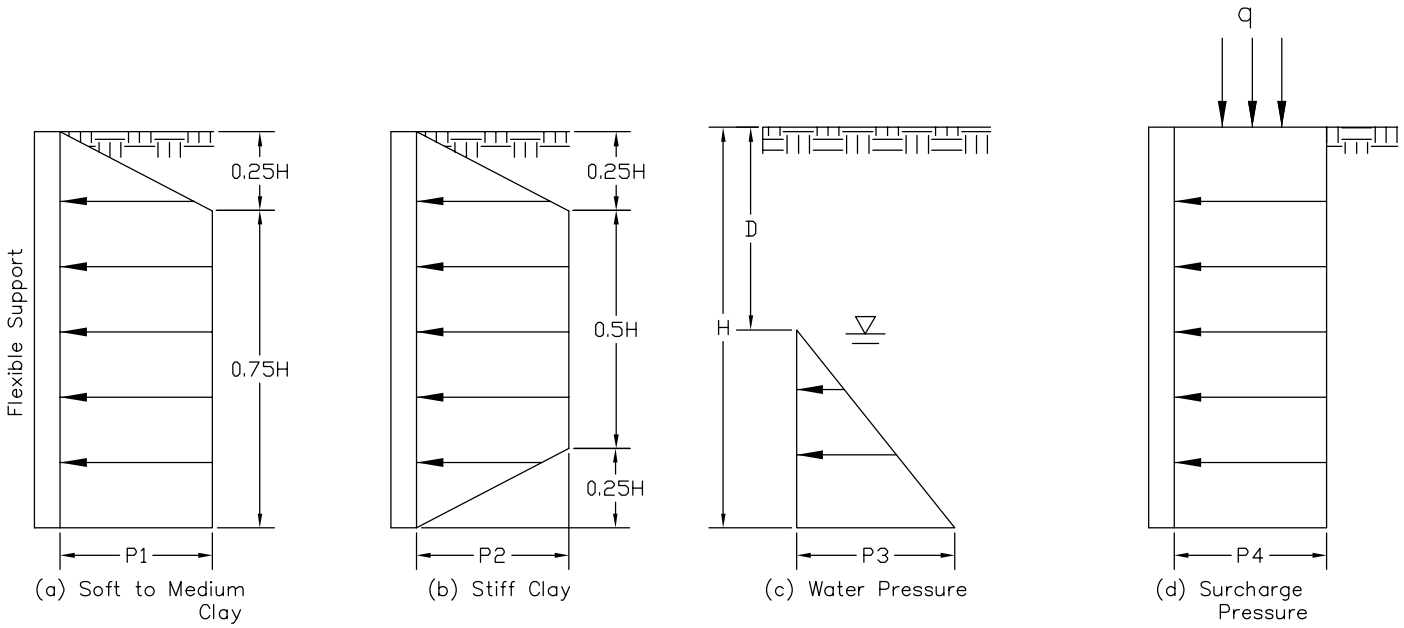




Reference: OSHA, Safety and Health Regulations for Construction, 1926 Subpart P.

AYLES
ENGINEERING CORP.

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



Empirical Pressure Distributions

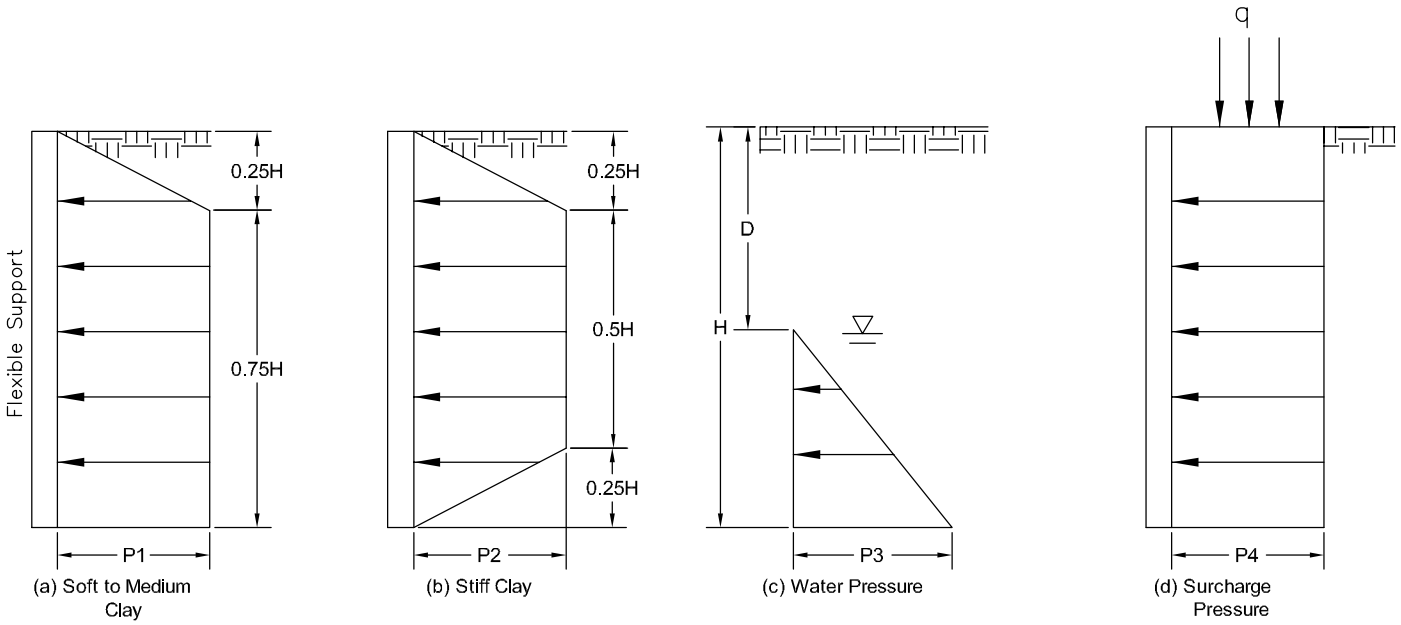
Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = γH-4C, psf
P2 = Lateral earth pressure = 0.4γH, psf
P3 = Water pressure = γ_w (H-D), psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight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

AYLES
ENGINEERING CORP.

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



Empirical Pressure Distributions

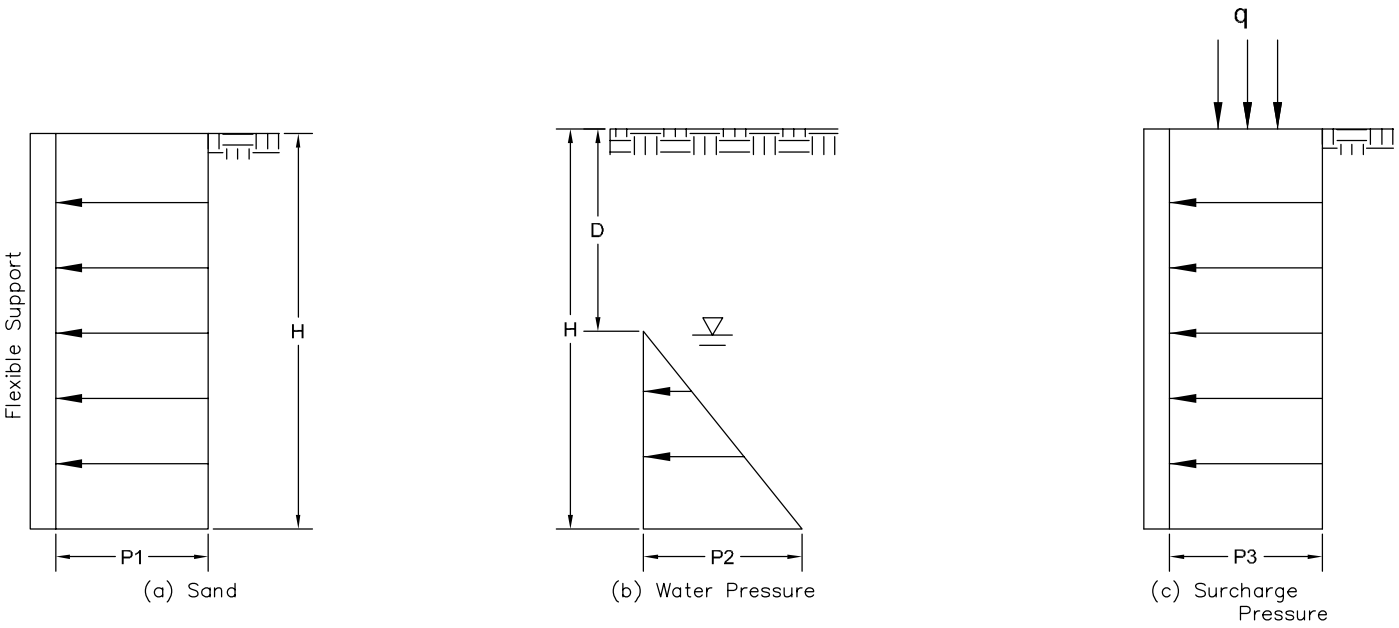
Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $\gamma H - 4S_u$, psf
P2 = Lateral earth pressure = $0.2\gamma H$, psf
P3 = Water pressure = $\gamma_w (H-D)$, psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight 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
ENGINEERING CORP.

LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN SAND



Empirical Pressure Distributions

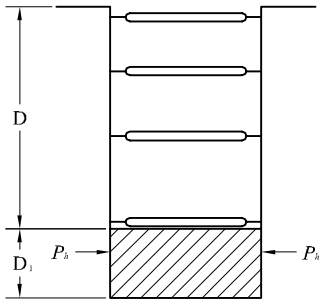
Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $0.65*\gamma HK_a$, psf
P2 = Water pressure = γ_w (H-D), psf
P3 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
K_a = Coefficient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

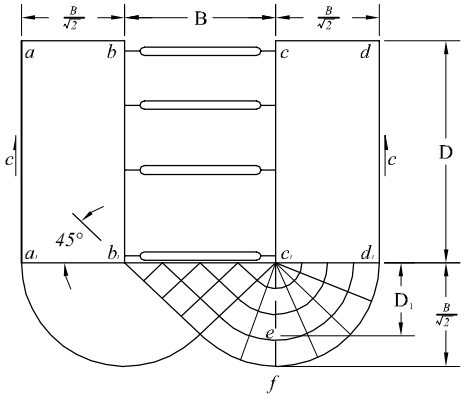
Notes:
1. All pressures are additive.
2. No safety factors are included.

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

AYLES
ENGINEERING CORP.

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

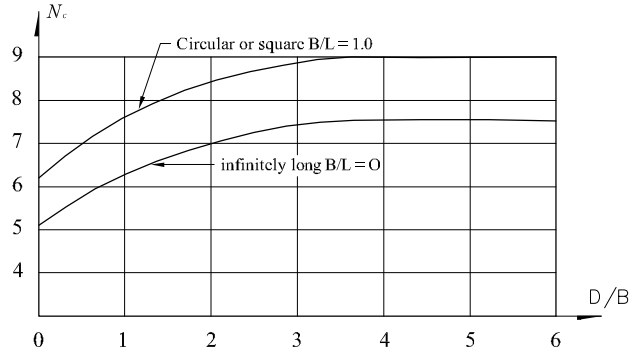
$$\text{Depth of Buried Length, } (D_1) = \frac{1.5(\gamma D + q) - NcC}{(C/B) - 0.5\gamma} \; ; \; D_1 \geq 5 \text{ ft.}$$

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

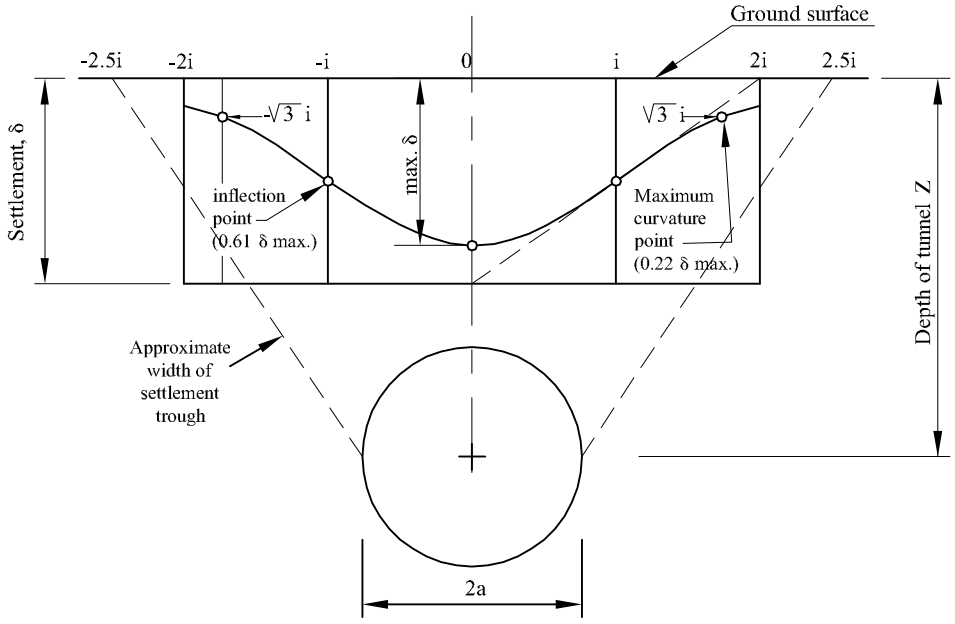
where; B = width of excavation



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

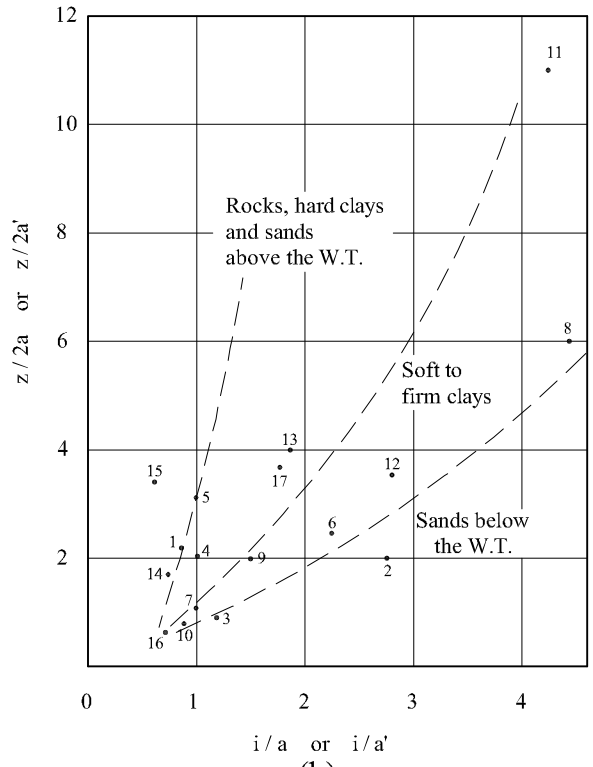
Reference: Bjerrum, L. and Eide, O., Stability of Strutted Excavations in Clay, Geotechnique, 6, 32-47 (1956).

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.