FINAL REPORT
GEOTECHNICAL INVESTIGATION
WATER LINE REPLACEMENT
IN INNER LOOP NORTH AREA
WBS NO. S-000035-0182-3
HOUSTON, TEXAS

PREPARED BY

ASSOCIATED TESTING LABORATORIES, INC.
HOUSTON, TEXAS

ATL REPORT NO. G13-120
August 26, 2013

ESTABLISHED 1959
TBPE Firm No. 4560

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Date: August 26, 2013

ATL Job No: G13-120

Cobb, Findley & Associates, Inc.
13430 Northwest Freeway, Suite 1100
Houston, Texas 77040

Attention: Ms. Amy Stonaker, P.E.

Reference: Final Geotechnical Investigation Report
Proposed Water Line Replacement in Inner Loop North Area
WBS No. S-000035-0182-3
Houston, Texas

Dear Ms. Stonaker:

We have completed this report for the geotechnical investigation for the above-referenced project. Our findings, geotechnical engineering analyses and recommendations are presented in this report.

It has been a pleasure working with you on this project. Should you have any questions concerning this project work, please call us at (713) 748-3717.

Sincerely,

ASSOCIATED TESTING LABORATORIES, INC.

STATE OF TEXAS
PENG SIA TANG
81150
REGISTERED PROFESSIONAL ENGINEER

8/26/13

Peng Sia Tang, P. E.
Manager, Geotechnical Services

Jasbir Singh, P.E.
President

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GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA

HOUSTON, TEXAS

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GEOTECHNICAL INVESTIGATION
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS

EXECUTIVE SUMMARY

Associated Testing Laboratories, Inc. (ATL) has completed the geotechnical study for the proposed replacement of existing water lines in the Inner Loop North Area, as shown in Figure 1. The project entails replacing the existing water lines with 8-inch diameter water lines, at depths ranging from about 5 to about 18 feet below existing grade (see Figures 2a through 2q).

Trenchless installation technique will mostly be employed. Open cut/trench excavation will be carried out at access pits (auger pits), and possibly in local areas where underground obstructions or site conditions warrant open cut/trenching.

The subsurface conditions investigated by 70 soil borings (to 12 to 23 feet below existing grade) along the project alignments, consists mostly of firm to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of borings. A surface Silty Sand (SM) stratum was found in the top 2 to 4 feet of Borings B-15 and B-20. In addition, a lower Silty Sand (SM) stratum was found between depths of about 10 to 20 feet below grade (some to the bottom of boring) in the following borings: B-16, B-17, B-20, B-25, B-49, B-67 and B-69.

Three additional 70-ft deep borings drilled at the Little White Oak Bayou at Enid Street and Link Road crossings revealed presence of predominantly form to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of borings at 70 feet. The top 16 and 30 feet of the clay soils found in Boring B-23 and B-24 are fill.

The detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4y.

Groundwater was encountered during drilling in Borings B-14, B-17, B-19, B-22 through B-24, B-40, B-59 through B-61, B-67 and B-69 at depths ranging from about 11.5 to 24 feet below existing grade, no groundwater was encountered in the remaining borings. At the end of drilling, groundwater was encountered in Borings B-14, B-17, B-19, B-22 through B-24, B-40, B-60, B-61 and B-67 at depths of about 9 to 23 feet, but no free water in the remaining borings. Borings B-3 (PZ-1), B-17 (PZ-3), B-20 (PZ-2), B-22 (PZ-4), B-42 (PZ-5), B-51 (PZ-4) and B-66 (PZ-7) were converted into piezometers after completion of drilling and soil sampling. Water level was measured in PZ-3 and PZ-4 after 24 hours at a depth of about 11 and 23 feet, respectively; the remaining piezometers were dry. Water level was measured in PZ-1 through PZ-7 at depths ranging from about 5.5 to 22 feet after 7 days, and at depths between about 4.5 to 22.5 feet after 30-days.

Our main geotechnical findings and recommendations are summarized below:

1. In Boring B-30 that is 14 feet deep, the driller did not notice hydrocarbon-like odor; however, light hydrocarbon-like odor was noted at the very bottom of the 14 feet deep Boring B-14 when inspected by the soils technician in the laboratory. Light hydrocarbon-like odor was noted in Boring B-55 during field drilling, and hydrocarbon-like odor was noted in Boring B-50 during field drilling. No observable unusual staining or hydrocarbon odors were noted in the remainder of the borings during our inspection of the soil samples. For further information, please refer to the Phase I and Limited Phase II Environmental Site Assessment conducted for this project.
2. A preliminary fault evaluation based on review of available fault maps and literature review indicated that the documented Pecore Fault is estimated to be about 0.15 to 0.2 miles north and northwest of the southern end of project area. A Phase I fault evaluation by a Professional Geologist knowledgeable is not recommended.
3. Based on currently proposed flow line depths and the subsurface conditions (see Figures 4a

through 4y), the water line installation excavations will be advanced mostly in firm to hard clay soils. However, water line installation excavation at/near Borings B-17 and B-20 (but not limited to) will likely to extend into silty sands (SM).

4. Based on the currently proposed invert elevation and the gathered groundwater information, the water line construction excavations at/near (but not limited to) Borings B-17 and B-20 will likely encounter groundwater; groundwater may also be encountered in some of the excavations exceeding about 5 feet and remain open for more than 24 hours. It should be noted that groundwater level will fluctuate with the amount of precipitation prior to and during the construction.
5. Geotechnical parameters/information and construction recommendations for the proposed open cut/trenching and trenchless installation of the proposed water lines are presented in Section 5.1. In Section 5.2, stability of existing earth slopes and the ultimate slope at 4H:1V of Little White Oak Bayou at Enid Street and Link Road crossings were evaluated, and the proposed allowable compression and tension capacity of the 16-inch square concrete piles supporting the water line aerial crossing at Enid Street were developed.
6. Construction considerations for the proposed water line replacement are discussed in Section 6.0.

GEOTECHNICAL INVESTIGATION
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS

1.0 INTRODUCTION

1.1 General

The geotechnical investigation for Water Line Replacement in Inner Loop North Area was authorized on January 9, 2013 by Cobb, Fendley & Associates, Inc. via execution of the Subcontract for Professional Services, and with the acceptance of the **Associated Testing Laboratories, Inc., (ATL)** Proposal No. CP12-1104R5 dated January 30, 2013. Project details were provided to ATL by Cobb, Fendley & Associates, Inc. This report includes results of the field investigation, laboratory testing, geotechnical engineering analysis and recommendations for the proposed water line replacement construction.

1.2 Location and Description of the Project

The project site is located in a mixed commercial and residential neighborhood, a Site Vicinity Map showing the project alignments is presented in Figure 1. Photographs of the project site were taken at the time of our site visit. These photographs are presented in Appendix 1.

The project entails replacing the existing water lines with 8-inch diameter water lines in the Inner Loop North Area in the City of Houston, Texas. The project alignments traverse streets in the Key Map 453 P, Q, S, T, U and W, as shown in Figures 2a through 2q.

The approximate invert depths of the proposed water lines at the proposed boring locations, based on the plan and profile drawings dated November 2012, range from about 5 to about 18 feet below

existing grade. Trenchless installation technique will mostly be employed.

The proposed water line alignments at the intersection of Link Rd. and Enid St. will cross the Little White Oak Bayou that is approximately 26 to 28 feet deep at the Link Road and Enid Street crossing. The aerial crossing at Link Road is to be supported on the existing bridge deck, and the aerial crossing at Enid Street will be supported on precast concrete piles; the pile tip elevation will be determined based on the ultimate channel section, scour and allowable pile bearing capacity. Mr. Srinivas Chintalapati, Ph.D., P.E. of KIT Professionals, Inc. verified in an e-mail dated January 15, 2013 that the existing channel sections at both crossings as presented in the plan and profile drawings are at or close to the ultimate channel depths, and the ultimate channel slopes would be 4H:1V.

1.3 Scope of Work

A geotechnical investigation was conducted to determine subsurface soil conditions along the proposed project alignment and to develop geotechnical engineering recommendations for the construction of new underground utilities consisting of water lines. **Associated Testing Laboratories, Inc. (ATL)** has completed a subsurface exploration program for this project consisted of the following scope:

- Augering through existing pavements at borings located within streets with asphaltic concrete (AC) pavements using the drill rig auger.
- Coring through pavements at borings located within streets with portland cement concrete (PCC) and PCC pavements with AC overlay using a pavement coring machine prior to soil boring and sampling.
- Drilling and sampling a total of seventy three (73) borings (Borings B-1 through B-73), sixty-nine of them to depths ranging from 12 to 23 feet below existing grade, and three (B-22, B-23 and B-24) to 70 feet below existing grade at the water line crossing Little White Oak

Bayou at Enid Street and at Link Road, for a total of 1,232.5 lineal feet of drilling, and installing four 17-ft, one 18-ft, one 23-ft and one 40-ft piezometers after completion of drilling and sampling.

- Conducting laboratory tests on selected soil samples recovered from the soil borings.
- City of Houston Geo-Environmental Branch provided information on the locations and logs of two borings (GB112 and GB113) drilled along Aurora St. between Oxford St. and N. Main St. the in a previous geotechnical investigation by other. ATL has incorporated information from these two soil borings in this report.
- Developing boring logs and boring log profiles to present the general subsurface soil and groundwater conditions.
- Conducting a preliminary fault review of the project area based on review of available fault maps and literature.
- Conducting geotechnical engineering analysis and provide geotechnical parameters and construction recommendations for the proposed water line replacement, slope stability analyses of earth slopes at aerial crossings of the water line across Little White Oak Bayou at Link Road and Enid Road, and pile foundation capacity for the aerial crossing at Enid Street.

2.0 SUBSURFACE INVESTIGATION PROGRAM

The field investigation for this project consisted of drilling and sampling a total of seventy-three (73) soil borings and installing seven (7) piezometer along the project alignments. The boring/piezometer locations and depths were approved during the proposal phase. The proposed borings and piezometers were selected based on criteria for borings and piezometers specified in City of Houston Department of Public Works and Engineering Design Manual, Chapter 11 “Geotechnical and Environmental Requirements”.

All except four of the boring locations were located within existing street pavements, with 60 borings located in existing asphaltic concrete (AC) pavements, and five in existing pavements with AC overlay over portland cement concrete (PCC) pavements, and four in existing PCC pavement. Borings located in existing PCC pavements (with and without AC overlay) were cored through using a pavement coring machine prior to soil boring and sampling. The information from our boring/piezometer and depths and the coordinates (northing and easting) are presented in the table below.

BORING AND PIEZOMETER INFORMATION

Boring		Piezometer		Location	Northing	Easting
No.	Depth, ft.	No.	Depth, ft.			
B-1	14	--	--	Eastman St.	13,862,485.36	3,116,290.33
B-2	13	--	--	E.28th St.	13,862,127.39	3,115,942.36
B-3 (PZ-1)	17	PZ-1	17	Eastman St.	13,861,820.48	3,116,325.50
B-4	15	--	--	Angeline St.	13,861,806.34	3,117,333.03
B-5	14	--	--	Samual St.	13,861,444.87	3,117,144.04
B-6	15	--	--	Service St.	13,861,108.29	3,116,028.07
B-7	13	--	--	Eastman St.	13,860,819.00	3,116,348.12
B-8	14	--	--	Service St.	13,861,069.85	3,116,793.75
B-9	17	--	--	Walton St.	13,862,101.77	3,117,793.96
B-10	18	--	--	Enid St.	13,861,746.13	3,118,142.80
B-11	14	--	--	Tabor St.	13,861,310.78	3,117,570.40
B-12	15	--	--	Enid St.	13,861,208.96	3,118,170.57
B-13	14	--	--	Eichwurzel Ln.	13,861,455.69	3,118,757.65
B-14	16	--	--	Eichwurzel Ln.	13,861,490.04	3,119,215.96
B-15	12	--	--	Eichwurzel Ln.	13,861,514.07	3,119,810.50
B-16	13.5	--	--	Robert Lee Rd.	13,861,069.14	3,118,871.02
B-17 (PZ-3)	23	PZ-3	23	Robert Lee Rd.	13,861,093.49	3,119,440.33
B-18	14	--	--	Leon St.	13,862,153.61	3,118,950.09
B-19	17	--	--	Delany St.	13,862,415.27	3,119,253.61
B-20 (PZ-2)	17.5	PZ-2	17	Delany St.	13,862,384.76	3,119,726.06
B-21	14	--	--	Link Rd.	13,860,627.37	3,117,506.14
B-22 (PZ-4)	70	PZ-4	40	Link Rd. at White Oak Bayou	13,860,525.73	3,118,142.74
B-23	70	--	--	Enid St. at White Oak Bayou	13,860,789.83	3,118,176.36

Boring		Piezometer		Location	Northing	Easting
No.	Depth, ft.	No.	Depth, ft.			
B-24	70	--	--	Link St. at White Oak Bayou	13,860,526.42	3,118,348.76
B-25	13.5	--	--	Link Rd.	13,860,411.96	3,119,023.65
B-26	15	--	--	Link Rd.	13,860,741.25	3,119,174.53
B-27	14	--	--	Dunlop St.	13,860,808.43	3,119,732.99
B-28	14	--	--	Karcher St.	13,860,195.97	3,119,513.44
B-29	13	--	--	Wynne St.	13,859,975.46	3,119,093.06
B-30	14	--	--	Wynne St.	13,860,019.14	3,119,996.92
B-31	12	--	--	Tarver St.	13,859,528.40	3,119,187.59
B-32	13	--	--	Cavalcade St.	13,859,073.33	3,119,284.65
B-33	12	--	--	Cortlandt St.	13,859,611.23	3,111,725.39
B-34	13	--	--	Arlington St.	13,860,219.39	3,112,050.32
B-35	15	--	--	Arlington St.	13,860,711.18	3,112,025.98
B-36	12	--	--	Aurora St.	13,861,029.65	3,111,759.69
B-37	16	--	--	Cortlandt St.	13,861,443.93	3,111,531.12
B-38	14	--	--	Cortlandt St.	13,861,998.41	3,111,504.02
B-39	17	--	--	Arlington St.	13,861,261.39	3,111,995.71
B-40	16	--	--	Arlington St.	13,861,726.28	3,111,972.33
B-41	16	--	--	Arlington St.	13,862,276.07	3,111,942.85
B-42 (PZ-5)	17	PZ-5	17	Aurora St.	13,861,061.96	3,112,449.24
B-43	14	--	--	Oxford St.	13,860,105.47	3,112,752.61
B-44	14	--	--	Oxford St.	13,860,561.85	3,112,730.92
B-45	12	--	--	E. 22nd St.	13,859,703.07	3,113,151.19
B-46	16	--	--	Aurora St.	13,861,090.74	3,112,999.10
B-47	15	--	--	Sheldon St.	13,859,432.49	3,113,776.38
B-48	12	--	--	E. 20th St.	13,859,073.58	3,113,710.28
B-49	16	--	--	E. 20th St.	13,859,041.76	3,114,003.58
B-50	13	--	--	E. 20th St.	13,858,920.22	3,110,676.45
B-51 (PZ-6)	18	PZ-6	18	E. 20th St.	13,858,929.83	3,111,124.22
B-52	15	--	--	E. 20th St.	13,858,970.24	3,111,705.25
B-53	15	--	--	E. 20th St.	13,859,009.01	3,112,516.94
B-54	14	--	--	Oxford St.	13,859,491.7	3,112,781.55
B-55	15	--	--	E. 20th St.	13,859,043.72	3,113,234.83
B-56	18	--	--	Harvard St.	13,858,610.1	3,111,440.45
B-57	12	--	--	Arlington St.	13,858,394.16	3,112,151.31
B-58	18	--	--	E. 18th St.	13,858,169.96	3,110583.51
B-59	17	--	--	E. 18th St.	13,858,199.67	3,111,156.87
B-60	15	--	--	E. 18th St.	13,858,234.82	3,111,864.3
B-61	15	--	--	E. 18th St.	13,858,258.14	3,112,453.26
B-62	12	--	--	Harvard St.	13,857,732.89	3,111,482.61

Boring		Piezometer		Location	Northing	Easting
No.	Depth, ft.	No.	Depth, ft.			
B-63	15	--	--	E. 16th St.	13,857,488.47	3,111,899.41
B-64	13	--	--	E. 16th St.	13,857,521.42	3,112,477.75
B-65	12	--	--	Arlington St.	13,856,766.00	3,112,207.11
B-66 (PZ-7)	17	PZ-7	17	Arlington St.	13,856,168.17	3,112,206.24
B-67	14	--	--	Arlington St.	13,855,574.3	3,112,264.85
B-68	12	--	--	Arlington St.	13,855,040.08	3,112,310.4
B-69	14	--	--	Arlington St.	13,854,679.18	3,112,326.43
B-70	15	--	--	Arlington St.	13,854,209.42	3,112,349.26
B-71	13	--	--	E. 12th 1/2 St.	13,855,199.42	3,113,103.09
B-72	12	--	--	E. 12th 1/2 St.	13,855,213.06	3,113,530.85
B-73	13	--	--	E. 12th 1/2 St.	13,855,241.40	3,114,085.16

Boring locations drilled in this geotechnical exploration are shown on Figures 2a through 2q. The boreholes were drilled dry to the bottom of the boring or to a depth where a borehole started caving in, after which rotary wash boring technique was carried out. In cohesive soils, undisturbed soil samples were collected using a conventional 3-inch O.D. Shelby tube in accordance with ASTM D1587. Cohesionless soils were sampled using split spoon sampler in accordance with ASTM D1586. All soil samples were examined, classified and logged in the field. A representative portion of each sample was packed in containers to prevent moisture loss. All soil samples were properly labeled and subsequently transported to the ATL laboratory.

Piezomenters ranging in depths from 17 to 40 feet were installed in Borings B-3, B-17, B-20, B-22, B-42, B-51 and B-66 after completion of drilling and sampling. The groundwater level information encountered in the boreholes during and at completion of drilling, and the water level in the piezometers after 24-hour, 7- and 30-day are presented in Table 2. The piezometers were pulled and plugged with cement-bentonite grout after the 30-day water level reading. The piezometer installation and plugging reports are presented in Appendix 2.

Upon completion of drilling, the borings where no piezometer was to be installed were backfilled using cement-bentonite grout using a tremie. The cored PCC pavements were patched using portland

cement concrete, and the augered AC pavements were patched using cold-mixed asphaltic concrete.

All soil samples were classified according to Unified Soil Classification System (ASTM D-2487). The soil and groundwater information found in each boring are shown on the individual boring logs presented in Appendix 3. A Key to Log Terms and Symbols is also presented in Appendix 3.

3.0 LABORATORY TESTING PROGRAM

Samples obtained from the field were again examined and classified in our laboratory by the geotechnical technician under the supervision of an engineer. Laboratory testing was performed on select soil samples collected during the field investigation. The laboratory testing program included Atterberg Limits (ASTM D-4318), Density, Moisture Content (ASTM D-2216), Unconfined Compressive Strength (ASTM D-2166), Unconsolidated Undrained Triaxial (ASTM D-2850), Percent Finer Than No. 200 Sieve (ASTM D-1140) and Grain Size Analyses with Hydrometer (ASTM D-422), Multi-Staged Consolidated-Undrained Triaxial Tests (ASTM D-4767), Crumb (ASTM D-6572) and Pinhole Tests (ASTM D-4647) tests. The results of laboratory tests are presented on the boring logs in Appendix 3 and summarized in the Summary of Test Results in Table 4. Results of the crumb, pinhole and triaxial consolidated-undrained tests are presented in Appendix 4. Overall numbers and types of tests performed for this study for this project are presented below:

TYPE OF TEST	NUMBER OF TEST
Dry Density	117
Moisture Content	585
Atterberg Limits	167
Unconfined Compression	93
Sieve Analysis through No. 200 Sieve	117

TYPE OF TEST	NUMBER OF TEST
Grain Size Analyses with Hydrometer	2
Unconsolidated Undrained Triaxial	19
Multistage Consolidated-Undrained Triaxial	2
Crumb	14
Pinhole	3

4.0 SUBSURFACE AND SITE CONDITIONS

4.1 Geology of Coastal Plain

The proposed project area is located within the Gulf Coast Structural Province, a huge sedimentary basin containing several thousand feet of sediments. In general, these sediments consist of loose sands, silts and clays which slope gently toward the Gulf of Mexico.

The proposed project site is underlain by the Beaumont Formation of the Pleistocene age. This formation consists of over consolidated clays, silts and sands with some shell, calcium carbonate and iron oxides. These formations are quite strong and extend to an approximate depth of 100 feet. The surface materials are often weakened by the weathering process.

The materials of Beaumont Formation were deposited during the last of the interglacial periods. During interglacial periods when water from the melting glaciers flowed back into the ocean, the sea rose, the depended valley backfilled and several Pleistocene formations were deposited. Beaumont Formation may have been deposited during a mid-Wisconsin interglacial interval or during the Sangamon Stage, an interval between the Wisconsin and Illinoian Glaciations. The Sangamon Stage is estimated to be about 70,000 years ago. The Beaumont formation is the youngest formation of Pleistocene age that crops out in the proposed project area. Its origins are mainly fluvial and deltaic,

but probably some small areas originated as coastal marsh and lagoonal deposits.

4.2 Geologic Faults

Among the geologic and geomorphological features in this region are sedimentary deposits broken by structure such as normal faults, salt domes, etc. The sedimentary deposits slope gently toward the Gulf of Mexico. They are broken by normal faults, most of which dip toward the Gulf and extend downward many thousands of feet. The earth movements that caused these faults took place within the last 50,000 years. In general, the regional faults in the Houston area trend parallel to the Gulf Coast. Only the local faults over the salt domes show a radial pattern associated with the upthrust of the salt mass. There are numerous faults and fault systems in the Greater Houston and surrounding area. The movements of many of these faults has been affected in recent history by area subsidence. The subsidence is theorized to have been associated with the removal of oil and groundwater. As much as nine (9) feet of subsidence has occurred in the area east of Houston in the last 70 years. Conversion to surface water usage and the limiting of oil production has greatly reduced the subsidence rate in the area east of Houston.

Figures 3a and 3b show the principal active faults in the Houston-Harris County area interpreted from the following sources: Principal Active Faults in Houston Metropolitan Area (Van Siclen, O'Neil, with updates from Norman, 2004); LIDAR Imagery (USGS, HGAC, Khan and Engelkemeir). Based on interpretation of the preceding information, the project alignments are located between Eureka Heights Fault to the north and Pecore Fault to the south. The southernmost part of the project alignments is located approximately 0.15 to 0.2 miles north and northwest of Pecore Fault (note that the estimated distance is subject to the accuracy of the published fault maps). No obvious physical evidence of fault movements was noted along the proposed project alignments during our cursory site reconnaissance. ATL does not recommend a Phase I Geological Fault Study at this time. However, if additional information regarding the Pecore Fault is needed, a Professional Geologist knowledgeable in geological faulting of Houston-Harris County should be consulted.

4.3 Potentially Hazardous Material

In Boring B-30 that is 14 feet deep, the driller did not notice hydrocarbon-like odor; however, light hydrocarbon-like odor was noted at the very bottom of the 12 to 14 feet soil sample by the soils technician in the laboratory. Light hydrocarbon-like odor was noted in Boring B-55 during field drilling, and hydrocarbon-like odor was noted in Boring B-50 during field drilling. No observable unusual staining or hydrocarbon odors were noted in the remainder of the borings during our inspection of the soil samples. For further information, please refer to the Phase I and Limited Phase II Environmental Site Assessment conducted for this project.

4.4 Subsurface Soil Stratigraphy and Geotechnical Characterization

***Existing Pavement Material*:** All except four of the boring locations were located within existing street pavements, with 60 borings located in existing asphaltic concrete (AC) pavements, and five in existing portland cement concrete (PCC) pavements with AC overlay, four in existing PCC pavement, and one in an area with stabilized shell base. The existing PCC pavements were cored through using a pavement coring machine prior to soil boring and sampling; the AC pavements were drilled through using the drilling rig auger. A summary of the existing pavement sections encountered at each boring location is presented in Table 1. Based on the pavement information gathered from our field investigation, the existing PCC pavements of the existing streets along the project alignments ranges in thickness from about 1 to 7.25 inches; some of the PCC pavements have between about 1.25 to 4.75 inches of AC overlay, and some with about 1 to 7 inches of sand/shell/crushed limestone base. The existing asphaltic concrete (AC) pavements consist of about 2 to 11 inches of AC surface and underlain by about 3 to 20 inches of base ranging from crushed stones/shell/limestone, gravel and stabilized shell.

The PCC pavement materials and section thicknesses were based on inspection of cores from the

pavement coring. The AC pavement material and thicknesses were estimated from the cuttings from the drill rig auger. The actual material and thicknesses in the field, at or near the boring locations, may differ from those described in the Table 1.

***Subsurface Soil Stratigraphy*:** Based on our soil borings, the subsurface soils along the project alignments consists generally of following:

Along Eastman Street (Profile 4a): The subsurface soils below the existing pavements consist of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-1, B-3 and B-7 at 13 to 17 feet.

Along Airline Drive (Profile 4b): The subsurface soils below the existing pavements consist of stiff to hard Fat Clay (CH) to the bottom of Borings B-2 and B-6 at 13 to 15 feet.

Along Service Street (Profile 4c): The subsurface soils below the existing pavements consist of stiff to hard Lean Clay (CL) and Fat Clay (CH), to the bottom of Borings B-6 and B-8 at 14 to 15 feet.

Along Tabor Street (Profile 4d): The subsurface soils below the existing pavements consist of stiff to hard Lean Clay (CL) to the bottom of Borings B-11 and B-21 at 14 feet below existing grade.

Along Eichwurzel Lane (Profile 4e): The subsurface soils below the existing pavements consist of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-13 through B-15 at 12 to 16 feet below existing grade.

Along Robert Lee Road (Profile 4f): The subsurface soils below the existing pavements consist of an upper stratum of firm to very stiff Lean Clay (CL) and Fat Clay (CH), which is underlain by a stratum of loose to medium dense Silty Sand (SM) that exists to a depth of about 20 feet in Boring B-17 (to the bottom of Boring B-16 at 14 feet). The Silty Sand stratum is underlain be hard Fat Clay

(CH) to the bottom of Boring B-17 at 23 feet.

Along Leon/Delany Street (Profile 4g): The subsurface soils below the existing pavements consist predominantly of firm to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-18 through B-20 at 14 to 17.5 feet below existing grade. In Boring B-20, an upper Silty Sand (SM) stratum exists below the pavements to a depth of about 4 feet, and a lower medium dense Silty Sand (SM) stratum exists from a depth of about 10 feet to the bottom of boring at 17.5 feet.

Along Wynne Street (Profile 4h): The subsurface soils below the existing pavements consist of a firm to hard Lean Clay (CL) and Fat Clay (CH) that exists to the bottom of Borings B-29 and B-30 at 13 to 14 feet below existing grade.

Along E. 22nd Street (Profile 4i): The subsurface soils below the existing pavements consist of firm to stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-33 and B-45 at 12 feet below existing grade.

Along Karcher Street (Profile 4j): The subsurface soils below the existing pavements consist of an upper firm to very stiff Lean Clay (CL) and Fat Clay (CH) to a depth of about 14 feet (B-28 is 14 feet deep). In Boring B-17, a stratum of loose to medium dense Silty Sand (SM) exists below the upper clay stratum to the depth of about 20 feet, and is underlain by a stratum of hard Fat Clay (CH) to the bottom of boring at 23 feet below existing grade.

Along I-45 Frontage Road (South-Bound) - 1 of 2 (Profile 4k): The subsurface soils below the existing pavements consist predominantly of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-9, B-10 and B-13 at 14 to 17 feet below existing grade. In Borings B-16 and B-25, the Lean Clay and Fat Clay stratum exists to a depth of about 12 feet, and is underlain by medium dense Silty Sand (SM) to the bottom of boring at 13.5 feet below the existing grade.

Along I-45 Frontage Road (South-Bound) - 2 of 2 (Profiles 4l): The subsurface soils below the existing pavements consist of stiff to hard Lean Clay (CL) to the bottom of Borings B-29, B-31 and B-32 at a depth of 12 to 13 feet below the existing grade. The very stiff to hard Lean Clay found in Boring B-32 is fill.

Along Cortlandt Street (Profile 4m): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-33, B-37 and B-38 at a depth of 12 to 16 feet below existing grade.

Along Arlington Street - 1 of 3 (Profile 4n): The subsurface soils below the existing pavements consist predominantly of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-B-66 through B-70 at a depth of 12 to 17 feet below existing grade. In Borings B-67 and B-69, the Lean Clays and Fat Clay stratum exists to a depth of about 12 feet, and is underlain by medium dense Silty Sand (SM) to the bottom of boring at 14 feet below the existing grade.

Along Arlington Street - 2 of 3 (Profile 4o): The subsurface soils below the existing pavements consist predominantly of stiff to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-34, B-57 and B-65 at a depth of 12 to 13 feet below existing grade.

Along Arlington Street - 3 of 3 (Profile 4p): The subsurface soils below the existing pavements consist of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-35, B-39 thorough B-41at a depth of 15 to 17 feet below existing grade.

Along Aurora Street (Profile 4q): The subsurface soils below the existing pavements consist of stiff to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-36, B-42 and B-46 at a depth of 12 to 17 feet below existing grade. In Borings GB-112 and GB-113 drilled by other in 1994, stiff to hard Lean Clays (CL) and Fat Clays (CH) were found to the bottom of Boring GB-112 at 20 feet, and to a depth of about 21 feet in Boring GB-113, below that medium dense Sandy Silt (ML) was

found to the bottom of boring at 25 feet.

Along Oxford Street (Profile 4r): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) to the bottom of Borings B-43, B-44, B-54 and B-53 at a depth of 14 to 15 feet below existing grade. In Boring GB-112 drilled by other in 1994, stiff to hard Lean Clay (CL) and Fat Clay (CH) were found to the bottom of boring at 20 feet.

Along Harvard Street (Profile 4s): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-56 and B-62 at a depth of 12 to 18 feet below existing grade.

Along E. 20th Street (Profile 4t): The subsurface soils below the existing pavements consist predominantly of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-48 through B-53, and B-55, at a depth of 12 to 18 feet below existing grade. In Boring B-49, a stratum of loose Silty Sand (SM) exists between depths of about 12 and 14 feet.

Along E. 18th Street (Profile 4u): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-58 through B-61 at a depth of 15 to 18 feet below existing grade.

Along E. 16th Street (Profile 4v): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) to the bottom of Borings B-63 and B-64 at a depth of 13 to 15 feet below existing grade.

Along 12-½ Street (Profile 4w): The subsurface soils below the existing pavements consist of firm to very stiff Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-71 through B-73 at a depth of 12 to 13 feet below existing grade. The top 4, 8 and 4 feet of the clay soils in Borings B-71 through B-73, respectively, are fill.

Along Enid Street (Profile 4x): The subsurface soils below the existing pavements consist predominantly of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of Borings B-10 and B-12 at 18 and 15 feet, respectively, and to the bottom of the 70-ft deep Borings B-22 and B-23. In Boring B-23, the top 16 feet of the soils are fill consisting of soft to very stiff Lean Clay (CL).

Along Link Road (Profile 4y): The subsurface soils below the existing pavements/ground surface consist predominantly of firm to hard Lean Clay (CL) and Fat Clay (CH) to the bottom of the 14 feet deep Boring B-21, and to the bottom of the 70-ft deep Borings B-22 and B-24. In Boring B-25, stiff to very stiff Fat Clay (CH) was found below the existing pavement to a depth of about 12 feet, below which medium dense Silty Sand (SM) was encountered to the bottom of boring at 13.5 feet. The top 30 feet of the subsurface soils in Boring B-24 are fill.

The detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4y. "CL", "CH", "SM" and "ML" are classes of soils described in the Unified Soil Classification System.

The lean clays (CL) found in the soil borings have liquid limits ranging between about 23 and 49%, and plasticity indices (PI) ranging between about 8 and 30%. The fat clay (CH) soils found in the soil borings have liquid limits ranging between about 50 and 80%, and plasticity indices ranging between about 31 and 56%.

4.4.1 Dispersive Potential of Onsite Soils

To evaluate the dispersiveness of the onsite clay soils at the Little White Oak Bayou crossings, we conducted crumb and pinhole tests on select clay soils from Borings B-22 through B-24. Results of the crumb and pinhole tests are presented in Appendix 4 and summarized in the table below.

Boring No.	Sample Depth, ft.	Crumb Test Grade			Date Tested	Pinhole Test Classification	Date Tested	Soil Classification
		2-Minute	1-Hour	6-Hour				
B-22	2 to 4	1	1	1	3/8/13	--	--	Lean Clay with Sand (CL) [LL=36; PI=19; %-#200=73]
B-22	6 to 8	1	1	1	3/8/13	--	--	Lean Clay with Sand (CL) [LL=42; PI=24; %-#200=83]
B-22	14 to 16	1	1	1	3/8/13	ND3	3/5/13	Fat Clay (CH), with calcareous nodules [LL=58; PI=38; % Passing #200=90]
B-22	23 to 25	3	4	4	3/8/13	--	--	Lean Clay (CL) [LL=30; PI=14; %-#200=95]
B-23	6 to 8	1	1	1	3/8/13	ND1	3/5/13	Fill: Lean Clay with Sand (CL) [LL=41; PI=24; % Passing #200=82]
B-23	8 to 10	3	4	4	3/8/13	--	--	Fill: Lean Clay with Sand (CL) [LL=37; PI=20; % Passing #200=78]
B-23	12 to 14	1	1	1	3/8/13	--	--	Fill: Lean Clay with Sand (CL) [LL=40; PI=23; % Passing #200=75]
B-23	23 to 25	3	4	4	3/8/13	--	--	Fat Clay (CH), with calcareous nodules
B-23	28 to 30	3	4	4	3/8/13	D1	3/6/13	Lean Clay (CL) [LL=27; PI=12; % Passing #200=99]
B-24	4 to 6	1	1	1	3/8/13	--	--	Fill: Sandy Lean Clay (CL) [LL=34; PI=18; %-#200=54]
B-24	10 to 12	1	1	1	3/8/13	--	--	Fill: Fat Clay (CH) [LL=62; PI=41; %-#200=90]
B-24	16 to 18	1	1	1	3/8/13	--	--	Fill: Lean Clay with Sand (CL) [LL=41; PI=24; %-#200=84]

Boring No.	Sample Depth, ft.	Crumb Test Grade			Date Tested	Pinhole Test Classification	Date Tested	Soil Classification
		2-Minute	1-Hour	6-Hour				
B-24	23 to 25	1 to 2	3	3	3/8/13	--	--	Fill: Lean Clay with Sand (CL) [LL=33; PI=17' %-#200=71]
B-24	28 to 30	4	4	4	3/8/13	--	--	Fill: Lean Clay with Sand (CL) [LL=27; PI=12; %-#200=84]

Notes: 1) Crumb test grades: 1 – Non dispersive 2 – Intermediate; 3 – Dispersive 4 – Highly dispersive

2) Pinhole test classifications: D1, D2 -- Dispersive; ND4, ND3 -- Slightly dispersive; ND2, ND1 -- Non dispersive

Results of the crumb and pinhole tests indicated that:

- Fill and natural Lean Clays (CL) and Fat Clays (CH) found in top 30 feet of Borings B-22 through B-24, that have PI above about 20, are generally non-dispersive to slightly dispersive.
- Fill and natural Lean Clays (CL) found in top 30 feet of Borings B-22 through B-24, with PI of about 20 or below, and clay soils containing a significant amount of sand/silt/calcareous nodules inclusion within matrix, are typically dispersive.

4.4.2 Suitability of Onsite Soils As Fill Material

Clean non-expansive lean clay soils (plasticity index between about 10 and 20%) can be used as select fill in their present condition. High plasticity fat and lean clays (PI>20%) are not suitable for use as select fill in their present condition; however, these soils in their present conditions may be used as random fill. High plasticity clay soils, if clean, can be treated with appropriate amount of lime and used as select fill; a lime dosage of 7% by weight is recommended for preliminary estimate purposes, but lime vs. pH and/or lime vs. PI series tests should be conducted to determine the optimum lime dosage.

Clean Lean Clays (CL) with PI between 15 and 30, with LL not exceeding 49, and containing between 60 and 85 percent sand-sized particles, and with pinhole classification of ND1 and ND2, may be used as select fill for slope improvements/construction.

4.5 Groundwater

Groundwater was encountered during drilling in Borings B-14, B-17, B-19, B-22 through B-24, B-40, B-59 through B-61, B-67 and B-69 at depths ranging from about 11.5 to 24 feet below existing grade, no free water was encountered in the remaining borings. At the end of drilling, groundwater was encountered in Borings B-14, B-17, B-19, B-22 through B-24, B-40, B-60, B-61 and B-67 at depths of about 9 to 23 feet below existing grade, but no free water in the remaining borings. Borings B-3 (PZ-1), B-17 (PZ-3), B-20 (PZ-2), B-22 (PZ-4), B-42 (PZ_5), B-51 (PZ-4) and B-66 (PZ-7) were converted into piezometers after completion of drilling and soil sampling. Water level was measured in PZ-3 and PZ-4 after 24 hours at a depth of about 11 and 23 feet, respectively; the remaining piezimeters were dry. Water level was measured in PZ-1 through PZ-7 at depths ranging from about 5.5 to 22 feet after 7 days, and at depths between about 4.5 to 22.5 feet after 30-days.

The groundwater information encountered during and at the end of drilling in the boreholes, and in the piezometer after 24 hours, 7 and 30 days are presented in Table 2. It should be noted that the groundwater conditions will fluctuate according to the amount of precipitation and the environments conditions at the site.

Perched water table may exist in permeable sand/silt lenses/seams/layers within clay stratum that can form pathways for percolated and infiltrated water. The rate of flow of groundwater produced by these layers will depend upon the weather conditions such as locations of size and continuity of the permeable layers/seams/lenses, and the amount of precipitation and ambient temperature etc., at the time of construction.

5.0 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

The proposed water line installation will likely involve augering, one of many trenchless construction technique. Construction of access pits (auger pits) will likely involve open cut/trench excavation; it is also possible that open cut/trenching construction may be carried out in local areas where underground obstructions or site conditions warrant the construction technique. Based on the plan and profile drawings, the water lines are proposed to be installed at depths ranging between about 5 and 18 feet.

5.1 Proposed Water Line Replacement

5.1.1 OSHA Soil Types

At the federal level, Occupational Safety and Health Act (OSHA) requires protective systems for all trenches exceeding 5 feet in depth. OSHA has developed a soil classification system to be used as a guideline in determining sloping and protective system requirements for trench excavations. This system has set forth a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing amounts of stability.

Stable Rock: Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type A: Cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) or greater.

However, no soil is Type A if:

- The soil is fissured; or
- The soil is subject to vibrations from heavy traffic, pile driving, or similar

effects; or

- The soil has been previously disturbed; or
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or greater; or
- The material is subject to other factors that would require it to be classified as a less stable material.

Type B:

- Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; or
- Granular Cohesionless soils, including angular gravel, silt, silty loam, and sandy loam, and in some cases, silty clay loam and sandy clay loam; or
- Previously disturbed except those which would otherwise be classified as Type C;
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- Dry rock that is not stable; or
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C:

- Cohesive soil with an unconfined compressive strength of 0.5 tsf or less; or
- Granular, including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
- Submerged rock that is not stable;. or
- Material is a sloped, layered system where the layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or steeper.

Based on the soil conditions from the borings and groundwater information from the borings and piezometers, ATL recommends classifying clay soils (CL/CH) up to a depth of 5 feet as OSHA Soil Type "B", and OSHA Soil Type "C" for clay soils below 5 feet, for the determination of allowable maximum slope or selection and design of the protective system. All fill soils, sands (SP/SM/SC), silts (ML), silty clays (CL-ML), if encountered, and any soils subject to hydraulic pressure or vibrations shall be classified as OSHA Soil Type "C".

5.1.2 Open Cut/Trench Excavation

The proposed water line installation will involve construction using trenchless techniques. However, construction of auger pits for the proposed water line installation will involve open cut/trench excavation, it is also possible that open cut and trenching may be carried out in local areas where underground obstructions or site conditions warrant such a construction technique.

The approximate flow line depths and the subsurface conditions found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4y. Accordingly, most of the water line installation excavation will be advanced mostly in firm to hard clays (CL/CH) soils. However, water line installation excavation at/near Borings B-17 and B-20 (but not limited to) will likely to extend into silty sands (SM).

The trench excavations can be made using cut slopes stepped back to stable slope, vertical cuts supported with sheet piles or other suitably designed retaining system. The excavation should be performed in accordance with the current OSHA 29 CFR Part 1926 of OSHA (Trench Safety System) and City of Houston Standard Specification, Section 02317 – Excavation and Backfill for Utilities.

Trenches should be provided with a proper trench support system. For the trench supporting system, the lateral pressures exerted on trench walls by stiff clays and cohesionless soils are presented in

Figure 5a. Where soft to firm cohesive soils are encountered, the lateral pressure may be computed as given in Figure 5b. Where cohesive soils are underlain by sandy soils, the lateral pressure may be computed as given in Figure 5c. Temporary earth retaining walls are sometimes designed assuming an equivalent fluid pressure, in such cases, a lateral earth pressure equivalent imposed by a 84 PCF and 102 PCF fluid is recommended for clay soils above and below the water table, respectively; in sandy soils, a lateral earth pressure equivalent imposed by a 48 PCF and 85 PCF fluid is recommended for soils above and below the water table, respectively. Timber shoring as outlined in 29 CFR Part 1926 of OSHA recommendation may be used in the construction of trench supporting system. Trench boxes are commonly used for trench safety without shoring or bracing in open-cut excavations with vertical walls. In all cases, excavations should conform to OSHA guidelines.

Vehicular and Other Surcharge Loadings: Under normal loading conditions, a surcharge magnitude of q psf can result in lateral earth pressure of about 0.5q in cohesive soils and about 0.4q in sandy soils. All surcharge loads to a distance of 0.5 times the wall height should be considered. Due to the likely presence of roadways along the proposed pipeline alignment, the effects of vehicular traffic should be considered while designing the lateral supporting systems. The highway loading imposed by a H20 truck on a pipe under various depths of soil cover is presented in Figure 6. Figure 7 presents Boussinesq's equation for computing both horizontal and vertical stresses imposed by a surface surcharge load.

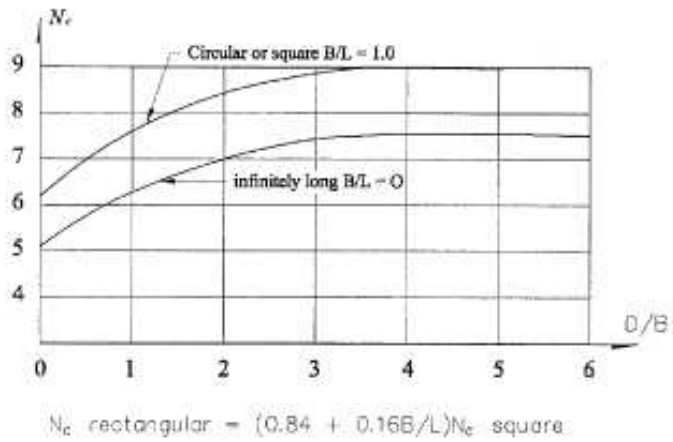
Stockpiling of excavated material should not be allowed near the excavation. Generally, a distance of at least one-half the excavation depth on both sides of the trench should be kept clear of any excavated material. If this is not possible due to space limitations then the retaining system design should be designed to take into account the surcharge loads.

In stable cohesive soils and where groundwater is lowered at least 3 feet below the excavation bottom, and if the sheeting terminates at the base of cut, the trench bottom stability can be evaluated in the following manner:

$$\text{Factor of safety } (F_s) = \frac{(N_c)\,C}{(\Upsilon)\,D + q}$$

Where,

N_c = Bearing capacity factor that depends on dimensions of the excavation:



C = Average undrained shear strength of clay in failure zone beneath and surrounding base of cut, psf.

Υ' = Average effective unit weight of soils above trench bottom, pcf.

q = Surface surcharge, psf.

D = Depth of trench, ft.

L = Length of trench, ft.

B = Width of trench, ft.

If the factor of safety is less than 1.5, sheeting should be extended below the base of the cut to insure stability. The extended sheeting depth should be at least 1.5 times the trench width.

5.1.3 ***Groundwater Control***

Groundwater encountered in the soil borings during and at completion of drilling, as well as the 24-hour, 7 and 30 day water level readings in the piezometers were presented in Section 4.4. It should

also be noted that fluctuations in groundwater levels may take place as a result of seasonal rainfall variations

The approximate flow line depths and the subsurface conditions as found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4y. Based on the proposed invert elevation and the groundwater information gathered during our field investigation, the water line construction excavations approaching at/near (but not limited to) Borings B-17 and B-20 will likely encounter groundwater; groundwater may also be encountered in some of the excavations exceeding about 5 feet and remain open for more than 24 hours. It should be noted that groundwater level will fluctuate with the amount of precipitation and the prevailing environmental conditions prior to and during construction.

Groundwater control for excavation in cohesive soils up to a depth of 15 feet can usually be accomplished by sump and pump arrangements because the seepage is relatively slow. For dewatering below the depth of about fifteen (15) feet multi-staged pumps will be required. When excavations extend into water-bearing sands/silts (may occur at (but not limited to) Borings B-17 and B-20), then dewatering using well points will be necessary. Criteria and requirements of City of Houston Standard Specification, Section 01578 – Control of Ground Water and Surface Water should be followed.

Seams and pockets of sand, silt, ferrous nodules, and calcareous nodules that may exist in cohesive soil layers may form communicative drainage paths for the groundwater, leading to potential water-bearing/perched water condition, and as a result, accelerated the rate of seepage. If such unexpected phenomenon is observed during the trench excavation and construction, appropriate measures, such as proper dewatering and shoring methods, may have to be implemented under supervision of a Professional Civil/Geotechnical Engineer.

5.1.4 Bedding Criteria

Where water line is installed using open cut method, the trench bottom for water line placement should be over-excavated to a minimum of 12 inches. For auger pits the over excavation should be to a minimum of 6 inches. The space should be filled with bank sand to a depth of at least 12-inches above the pipe top and compacted to a minimum of 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content between -3 to +5 percent of the optimum moisture content. The trench bottom should be shaped to receive the water pipe. The bedding details should be in accordance with the latest City of Houston Construction Details. City of Houston Drawing No. 02317-04 should be used for the water main bedding and backfill. The bedding and backfill for auger pit should be in accordance with City of Houston Drawing No. 02447-01.

Soft and/or wet soils, if encountered at trench bottom, should be handled according to requirements specified in City of Houston Standard Specifications Section 02317, Subsection 3.07, A and B.

5.1.5 Trench Backfill

The backfill should conform to standard City of Houston Specification, Section 02317 – Excavation and Backfill for Utilities. The backfill materials should conform to standard City of Houston Specification, Section 02320 – Utility Backfill Materials.

The embedment material between the pipe and the trench (bedding, haunching and initial backfill) may consist of bank run sand placed in maximum six-inches compacted lift thickness and compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor test (ASTM D698) at –3 to +5 percent of the optimum moisture content.

In the trench zone within the pavement area, the backfill may consist of bank run sand or select fill. The bank run sand should be placed in maximum 12 inches loose lift thickness and compacted by

vibratory equipment to a minimum of 95 percent of the maximum dry density at moisture content within zero percent to +5 percent of optimum as determined by ASTM D698. The select fill may be placed in maximum 6-inch compacted lift thickness and compacted to a minimum of 95 percent of the maximum dry density at moisture contents within 2 percent of optimum as determined according to ASTM D 698. The cut pavement should be replaced to match the existing pavement type and the thickness should be equal or greater then the existing pavement thickness. The finished pavement surface must be even with existing pavement elevation. In the trench zone outside the pavement area, a random backfill of suitable material (clayey soils) may be used. The random backfill may be placed in maximum 12 inches loose lift thickness for clayey soils and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 698 at moisture content necessary to achieve the density.

5.1.6 Loads on Buried Conduits

The pipelines placed at depths under the ground will be subject to loads due to backfill (earth loads) and loads due to vehicular traffic (live loads).

Earth Load: The earth loads on a buried pipe can be calculated based on Marston's formulae (Ref: 1 through 3). The Marston's equation for buried conduits are generally given as:

$$W_d = C_d \Upsilon B_d^2 \quad \text{- for rigid pipes}$$

$$W_d = C_d \Upsilon B_d B_c \quad \text{- for flexible pipes}$$

Where, W_d = fill load, in pounds per linear foot of pipe

C_d = Marston's soil coefficient

Υ = Unit weight of fill material, pcf (use 120 pcf)

B_d = Width of trench at or slightly below top of pipe, in feet

B_c = Width of pipe, in feet

The above equation is valid when the conduit is placed in a trench not wider than 2.0 to 3.0 times its outside width. Marston's soil coefficient C_d can be obtained from Table 4. K is the active earth pressure coefficient and μ is the coefficient of sliding friction between the fill material and the sides of the trench. The height of fill and the horizontal width of trench should be considered from the top of the conduit. For the above equation for flexible pipes, an assumption of equal stiffness of soil and pipe has been used for its development and the equation generally gives a minimum load value. Hence, for flexible pipes including ones installed using trenchless construction, the earth loads may be conservatively calculated using the prism load theory. The prism load (Ref: 1 through 3) determines the weight of the soil column directly above the pipe and neglecting factors such as side wall friction and/or the cohesion of the soils. The prism load (in psf) may be calculated by multiplying the total unit weight of soil above the pipe (say 120 pcf) by the height, H (ft) of the soil fill. The prism load generally gives higher loading on the pipe and simulates the long term load imposed on the pipe.

Vehicular Load: For calculation of live loads, the width of the loaded area should be taken as the outside horizontal width of the pipe. Loading due to H20 vehicle should be considered for vehicular traffic. Based on available information, the pipelines will be placed at depths ranging from about 5 to 9 feet below existing grade. The estimated highway loading on a buried conduit imposed by a H20 truck, under various soil cover, is presented on Figure 6.

Surcharge Load: The stresses imposed by a surcharge load can be estimated using Boussinesq's Equation presented on Figure 7.

5.1.7 Trenchless Construction

The proposed water lines will be installed using trenchless technique. In general, trenchless installation may involve dry auger or slurry auger method. In the dry auger method, the casing is

advanced by jacking while soils are excavated at the advancing end of the casing. In the slurry auger method, a small diameter pilot hole is first drilled between the access shafts, followed by reaming the pilot hole to full diameter by augering with slurry and installing casing or pipe by pull-back or jacking techniques. Requirements of City of Houston Standard Specification, Section 02447 – Augering Pipe and Conduit, should be followed.

The water line will be installed mostly in firm to hard clays, in which case the excavation face are anticipated to be stable. However, water line installation excavation at/near Borings B-17 and B-20 (but not limited to) will likely to extend into silty sands (SM). Excavation face in granular soils (sand/silt/gravel), soils with only slight plasticity and other caving soils will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, the following mitigating measures can be employed to improve the excavation stability:

1) Lower the groundwater table to at least 3 feet below the excavation bottom, and use colloidal drilling fluid (usually bentonite slurry) under controlled pressure to improve stability of the excavation.
2) In conditions where mitigation measures employed in Item 1 above cannot adequately provide the excavation stability, a casing can be installed at the same time of the slurry augering to provide stability of the excavation and reduce settlement at the surface.
3) In ground conditions where highly unstable soils and/or high inflow rate/pressure exist, microtunneling machine equipped with face shield and pressure-balancing colloidal drilling fluid may be used to maintain the stability of the excavation face.
4) Alternatively, open cut with shoring or other methods approved by City of Houston Department of Public Works and Engineering, along with groundwater control, and other stabilizing techniques such as chemical grouting, may be used at locations with difficult subsurface conditions or site constraints.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the

proposed water line by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew with experience in working with the selected trenchless construction technique in subsurface conditions similar to those found along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

Auger pit construction criteria provided in City of Houston Standard Specification, Section 02447 – Augering Pipe and Conduit, should be followed. Shoring systems for the auger pits may be designed based on the lateral earth pressures and other considerations discussed in Section 5.1.2.

Groundwater conditions were observed in open boreholes during the field investigation and in piezometers and the information were presented in Section 4.5. Water inflow in cohesive soils may be removed using a sump and pump arrangement. If the water inflow is large or where granular soils are encountered, dewatering using well points may be required to provide a dry working platform and to prevent soil boiling.

5.1.8 Effects of Trenchless Construction on Surrounding Structures

A properly designed and controlled augering/trenchless construction operation can reduce immediate soil movement and subsidence to a tolerable level. Nevertheless, some ground loss should be expected during any augering/trenchless construction operations. With good construction techniques, ground loss can be mitigated to acceptable levels. Augering/trenchless construction below pavement and buried utilities may lead to some future settlement due to loosening of the subgrade or bedding condition. Large ground loss can result from uncontrolled flowing ground. Such conditions may occur if water-bearing sands or silts are encountered (not encountered in our soil borings, but may be present away from the borings drilled) in the excavations along the augering/trenchless construction alignment. Measures to mitigate ground loss and other impacts of trenchless construction were addressed in Section 5.1.7.

The zone of influence of the augering/tunnel roughly extends to a distance equal to the invert depth on each side of the centerline of the augering/trenchless construction alignment. The amounts of settlement due to augering/trenchless construction are difficult to estimate. We anticipate that if good construction practices and control are exercised, the amount of ground settlements should be small. Establishing monitoring points on existing roadways, buildings and other important structures along the augering/trenchless construction alignments, and record coordinates and elevations prior to, during and after construction to monitor the amount of settlements or lateral movements due to augering/trenchless construction, and adjust augering/trenchless construction technique accordingly to mitigate the movements as necessary. Existing damages to the surrounding structures should be documented prior to starting of the augering/trenchless construction operations.

5.1.9 Thrust Restraint

Unbalanced thrust forces result from changes in flow directions and/or velocity in a pressurized pipe system (see Figure 8). The unbalanced thrust force and magnitude of thrust block force T is defined as follows:

$$T = 2\ PA\ \mathrm{Sin}\ (\theta/2)$$

Where,
- P = internal fluid pressure (psi);
- A = cross-sectional area of pipe (in^2);
- θ = deflection angle of bend; and,
- T = thrust force (pounds)

Adequate restraint may be achieved by using thrust blocks, restraint joints, tie rods, or a combination of these systems. The unbalanced force acting on a pipe system is transmitted by a thrust block and resisted by the bearing area between the pipe and the foundation soils. The unbalanced force acting on a pipe system with restraint joints are resisted by the frictional forces between the pipe/soil

interface across the pipe sections restrained to act integrally.

Thrust Blocks: Thrust blocks are commonly used to increase the bearing area to allow the fittings to resist movement. The procedures for thrust block design are given in detail in AWWA M9 (Ref. 1). The required thrust block bearing area is calculated based on the bearing capacity of the soil:

$$\text{Required Bearing Area of Thrust Block} = T/F$$

Where, T = thrust force (lb); and,

F = safe bearing value for soil (lb/sq.ft)

A safe bearing value of 1,500 psf can be used for thrust block design bearing on compacted soils. This value includes a factor of safety of 3. The blocks must be placed against undisturbed or compacted soils and the face of the block must be perpendicular to the direction of and centered on the line of action of the thrust. Proper care must be exercised after construction to prevent failure due to any future excavations behind the blocks.

Restrained Joints: Restrained joints are typically used to avoid the uncertainties of thrust blocking like future excavations, etc. A detailed procedure for designing restrained joints including example calculations is outlined in the AWWA design manual M9 (Ref. 1). The following soil parameters are recommended for the design of the restrained joint(s):

Average unit weight of soil, γ = 120 pcf

Cohesion of soils, C = 250/500/1000 psf (for soft/firm/stiff clays)

For coefficient of friction between pipe and granular soils, f, use 0.25 for smooth PVC and steel pipes, and use 0.3 for concrete pipes.

5.1.10 Flexible Pipe Deflection

The deflection of a flexible pipe may be determined using the modified Iowa formula of Watkins and Spangler (Ref. 2) as given below:

$$\Delta x = D_l \, [\, KWr^3 / (EI + 0.061\, E'\, r^3) \,]$$

Here EI is the pipe wall stiffness (in-lb.), r is the radius (in.) and W is the load per unit of pipe length (lb/in. in. of pipe). Where prism loads (i.e. weight of soil above the pipe) are used for pipe earth loads, a deflection lag factor, D_l of 1.0 may be used. Otherwise, deflection lag factor, D_l of 1.5 should be used. The bedding constant, K, may be taken as 0.1. The following typical soil parameters are recommended:

Soil Type	**Soil Consistency**	**Unit Weight, pcf**	**Shear Strength (c), psf or SPT Blow Counts, blows/ft**	**Modulus of Soil Reaction, psi/in**
Fat Clays and Lean Clays	Soft	120	$c \leq 250$	100
	Firm	124	$c \leq 500$	300
	Stiff	128	$c \leq 1{,}000$	600
	Very Stiff	130	$c \leq 2{,}000$	1,000
	Hard	132	$c > 2{,}000$	2,000
Granular Soils: Sands, Silts and Gravel	Loose	110	$2 \leq N_{SPT} \leq 7$	300
	Loose to Medium Dense	113	$8 \leq N_{SPT} \leq 15$	600
	Medium Dense	115	$16 \leq N_{SPT} \leq 30$	1,000
	Dense	118	$N_{SPT} > 30$	2,000

* Buoyant soil unit weight is computed by subtracting unit weight of water from the soil unit weight

5.1.11 Buoyant Uplift

Portion of a buried structure located below the water table is subject to an upward hydrostatic pressure, called the *buoyant uplift pressure*. Resistance to buoyant uplift pressure is provided by the following components:

- *Weight of the structure (W)*

- *Weight of the soil above the base extension beyond the wall(Ws)*
- *Frictional force between the soil and foundation (Fs).*

Buoyant Uplift Resistance = W + Ws + Fs

W and Ws are can be readily computed. The computation of the buoyant uplift, and the skin friction resistance are shown in Figure 9. If base extension option is used, we recommend using a buoyant unit weight of backfill soil above the base extension of 65 pcf when computing Ws.

5.2 Aerial Crossings of Water Line Across Little White Oak Bayou

The proposed water line alignments along Link Road and Enid Street will cross the Little White Oak Bayou and the depth of the bayou at the crossing is approximately 26 to 28 feet (see Figure 10a and 10b for cross section drawings of these two crossings). The proposed water line aerial crossing at Link Road is proposed to be supported on the existing bridge deck, and the aerial crossing at Enid Street will be supported on precast concrete piles; the pile tip elevation will be determined considering the ultimate channel section, scour and the allowable pile bearing capacity.

Mr. Srinivas Chintalapati, Ph.D., P.E. of KIT Professionals, Inc. verified in an e-mail dated January 15, 2013 that the existing channel sections at both crossings as presented in the plan and profile drawings are at or close to the ultimate channel depths. According to HCFCD, the ultimate channel section will have 4H:1V side slopes. The ultimate channel section will be constructed in the future when the Link Road and Enid Street bridges are upgraded.

ATL understands that no modification to the existing earth slopes is planned for the construction of both the proposed water line aerial crossings; however, incidental construction excavations that are small and localized in area may occur during the water line installation and bridge foundation construction. The stability of the existing earth slopes and the proposed ultimate channel slopes at 4H:1V at the two crossings is evaluated, and if necessary, the ultimate slope inclination that can

provide adequate factors of safety against slope instability is determined. Results of the slope stability analyses are also considered in developing the allowable bearing capacity of the precast concrete piles supporting the water line aerial crossing at Enid Street.

5.2.1 Slope Stability Analyses at Link Road and Enid Street Crossings

The objectives of the slope stability analyses are: (i) to evaluate the stability of the existing earth slopes of Little White Oak Bayou at the Link Road and Enid Street crossing; (ii) to evaluate the stability of the proposed ultimate channel section at 4H:1V of Little White Oak Bayou at the Link Road and Enid Street crossing; (iii) if necessary, evaluate slope inclination that will provide adequate factors of safety against short and long term and rapid drawdown slope instability; and, (iv) to provide appropriate design and construction recommendations for the proposed water line crossings based on the results of the slope stability analyses of the existing slopes and the ultimate design slopes.

5.2.1.1 Existing Slope Conditions

In general, the earth slopes near the Link Road and Enid Street bridge crossings are non-uniform and with segments of steeper slopes. Concrete rubble can be observed along the surface of the slopes at both crossings, especially near the bottom half of the earth slopes.

The existing bridge at Link Road crossing is supported on concrete piles. The slopes directly under the Link Road bridge is paved with concrete. The existing west earth slope (outside the concrete slope paving) at the Link Road crossing, as surveyed, has an upper slope with inclination of about 1.5H:1V to 2.57H:1V, a middle flatter plateau with inclination of about 3.6H:1V to 11H:1V, and a steep lower slope with inclination between about 0.4H:1V, with a bank-to-toe inclination of approximately 2.73H:1V. The existing east slope (outside the concrete slope paving) at the Link Road crossing, as surveyed, has an upper slope with inclination of about 1.15H:1V, a middle flatter

plateau with inclination of about 3H:1V, and a lower slope with inclination of about 1.76H:1V, with a bank-to-toe inclination of approximately 2.1H:1V.

The existing bridge at Enid Street crossing is supported by timber piles. Timber retaining walls were observed at the bridge crossing. The existing south slope at the Enid Street crossing, as surveyed, has inclination ranging from about 1.3H:1V to 2.3H:1V, with a bank-to-toe slope inclination of approximately 1.9H:1V. The existing north slope at the Enid Street crossing, as surveyed, has inclination ranging from about 1.11H:1V to 1.18H:1V, with a bank-to-toe slope inclination of approximately 1.16H:1V.

5.2.1.2 Conditions Analyzed for Slope Stability

We begin the slope stability analyses using the surveyed existing earth slopes at each crossing. If the analyses indicated inadequate factors of safety against local and global slope stability, we proceeded to conduct additional analyses assuming the slopes are trimmed to a flatter slope until adequate factors of safety were obtained.

S*ubsurface soil information from Borings B-22, B-23 and B-24 were used to develop soil stratigraphy and parameters for the slope stability analyses.*

5.2.1.3 Slope Stability Analyses

We conducted the slope stability analyses to evaluate the global slope stability of the earth slopes using Modified Bishop Method and the computer program SLIDE 6.0. The earth slopes were analyzed for the short term, long term and rapid drawdown conditions.

- End-of-Construction Condition - This condition models loading condition at the end of construction where there is no time for the consolidation of the soils to occur and the load-induced excess pore water pressure to dissipate. Unconsolidated-undrained shear strength

parameters were used for this analysis. For this analysis, a piezometric surface at approximate elevation of +33 feet was assumed for the channel slope stability analyses. The piezometic surface was based on piezometer water level observations.

- Long Term Condition - This condition models the long-term steady-state seepage case for the long term stability of the earth slopes, where the slope soils are allowed to consolidate under self-weight and sustained loading and the load-induced pore water pressure is allowed to dissipate over time. For this analysis, a piezometric surface at approximate elevation of +33 feet was assumed for the channel slope stability analyses. The piezometic surface was based on piezoemter water level observations.
- Rapid Drawdown Condition - According to HCFCD, the majority of slope failures in the Harris County/Houston area occur under rapid drawdown loading conditions. This condition models the condition where the entire slope soils are fully saturated due to a sustained period of rain or flood, then subject to rapid drawdown, resulting in stress increase created by the rapid drawdown of the basin/channel water, with no time for dissipation of excess pore pressure. For this analysis, a piezometric surface located at the top of bank, along the slope surface, and along the basin/channel bottom was assumed.

The shear strength parameters for the short term loading condition used in the slope stability analyses were based on the soils' index properties, in-situ shear strength estimates (hand penetrometer and Standard Penetration), as well as unconfined compression, and the triaxial of unconsolidated-undrained test results. In our long term and rapid drawdown analyses, we used shear strength parameters derived based on the soils' index and strength properties, results of triaxial consolidated-undrained tests on soils with pore pressure measurement, as well as consideration of mobilized shear strength due to soil softening/weathering effects as reported in publications by Mesri, et. al. and Stephen Wright.

A ground surface surcharge load of 250 psf was assumed in our analysis to simulate traffic and other incidental loading. If surcharge higher than those assumed in this analysis is anticipated, please

inform us.

The slope configuration, soil stratigraphy and shear strength parameters, piezometric and surcharge loading conditions considered in each case of the slope stability analyses are presented in the slope stability analyses outputs in Appendix 5.

HCFCD requires a minimum Safety Factor (SF) of 1.3 for the short-term condition, 1.5 for the long-term condition, and 1.25 for the rapid drawdown.

5.2.1.4 ***Results of Slope Stability Analyses***

Location		**Slope Description**	**Slope Stability Factor of Safety**		
			Short Term Condition (Target FS: ≥1.3)	**Long Term Condition (Target FS: ≥1.5)**	**Rapid Drawdown Condition (Target FS: ≥1.25)**
Little White Oak Bayou at Link Road Crossing	West Slope (B-22)	Existing Slope	1) No shallow depth sloughing circle with at slope surface 2) No local slip circle with FS < 1.3 3) Global stability FS of the slope soils is 2.33, above the target FS of 1.3. **[see Figure 5-1]**	1) Shallow depth sloughing circle FS along slope surface is 0.47, indicating surface soil sloughing 2) Local slip circle FS is 1.0, indicating imminent local slope failure 3) Global stability FS of the slope soils is 1.48, marginally below the target value of 1.5 **[see Figure 5-2]**	1) Shallow depth sloughing circle FS along slope surface is 0.35, indicating surface soil sloughing 2) Local slip circle FS is 0.68, indicating local slope failure 3) Global stability FS of the slope soils is 1.12, less than the target value of 1.25 **[see Figure 5-3]**
		Trimmed to 3H:1V Slope (B-22)			1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) No local slip circle with FS<1.25 3) Global stability FS of the slope soils is 1.15, below the target value of 1.25 **[see Figure 5-4]**

Location		Slope Description	Slope Stability Factor of Safety		
			Short Term Condition (Target FS: ≥1.3)	**Long Term Condition (Target FS: ≥1.5)**	**Rapid Drawdown Condition (Target FS: ≥1.25)**
Little White Oak Bayou at Link Road Crossing	West Slope (B-22)	Trimmed to 4H:1V Slope (B-22)		1) No shallow depth sloughing circle with FS<1.5 along slope surface 2) No local slip circle with FS<1.5 3) Global stability FS of the slope soils is 1.73, above the target value of 1.5 **[see Figure 5-5]**	1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) No local slip circle with FS<1.25 3) Global stability FS of the slope soils is 1.39, above the target value of 1.25 **[see Figure 5-6]**
Little White Oak Bayou at Link Road Crossing	East Slope (B-24)	Existing Slope	1) No shallow depth sloughing circle with FS<1.3 at slope surface 2) No local slip circle with FS < 1.3 3) Global stability FS of the slope soils is 1.85, above the target FS of 1.3. **[see Figure 5-7]**	1) Shallow depth sloughing circle FS along slope surface is 1.15, below target value of 1.5 2) Local slip circle FS is 1.05, indicating the slope is close to local slope failure 3) Global stability FS of the slope soils is 1.12, below the target value of 1.5 **[see Figure 5-8]**	1) Shallow depth sloughing circle FS along slope surface is 0.66, indicating sloughing failure 2) Local slip circle FS is 0.85, indicating local slope failure 3) Global stability FS of the slope soils is 1.01, indicating the slope is close to glonal slope failre **[see Figure 5-9]**
		Trimmed to 3H:1V Slope (B-24)			1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) Local slip circle FS is 1.14, below target value of 1.25 3) Global stability FS of the slope soils is 1.12, below the target value of 1.25 **[see Figure 5-10]**

Location		Slope Description	Slope Stability Factor of Safety		
			Short Term Condition (Target FS: ≥1.3)	**Long Term Condition (Target FS: ≥1.5)**	**Rapid Drawdown Condition (Target FS: ≥1.25)**
Little White Oak Bayou at Link Road Crossing	East Slope (B-24)	Trimmed to 4H:1V Slope (B-24)		1) No shallow depth sloughing circle with FS<1.5 along slope surface 2) No local slip circle with FS<1.5 3) Global stability FS of the slope soils is 1.73, above the target value of 1.5 **[see Figure 5-11]**	1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) No local slip circle with FS<1.25 3) Global stability FS of the slope soils is 1.40, above the target value of 1.25 **[see Figure 5-12]**
Little White Oak Bayou at Enid Street Crossing	South Slope (B-22)	Existing Slope	1) No shallow depth sloughing circle with FS<1.3 at slope surface 2) No local slip circle with FS < 1.3 3) Global stability FS of the slope soils is 1.86, above the target FS of 1.3. **[see Figure 5-13]**	1) Shallow depth sloughing circle FS is 1.21, below the target value of 1.5 2) Local slip circle FS is 1.08, way below the target value of1.5 3) Global stability FS of the slope soils is 1.22,below the target value of 1.5 **[see Figure 5-14]**	1) Shallow depth sloughing circle FS along slope surface is 0.87, indicating sloughing failure 2) Local slip circle FS is 0.82, indicating local slope failure 3) Global stability FS of the slope soils is 0.89, indicating global slope failure **[see Figure 5-15]**
		Trimmed to 2H:1V			1) Shallow depth sloughing circle FS along slope surface is 1.23, below the target value of 1.25 2) Local slip circle FS is 0.94, indicating local slope failure 3) Global stability FS of the slope soils is 0.91, indicating global slope failure **[see Figure 5-16]**

Location		Slope Description	Slope Stability Factor of Safety		
			Short Term Condition (Target FS: ≥1.3)	**Long Term Condition (Target FS: ≥1.5)**	**Rapid Drawdown Condition (Target FS: ≥1.25)**
Little White Oak Bayou at Enid Street Crossing	South Slope (B-22)	Trimmed to 3H:1V			1) No shallow depth sloughing circle with FS<1.25 2) Local slip circle FS is 1.16, below the target value of 1.25 3) Global stability FS of the slope soils is 1.27, slightly above the target value of 1.25 **[see Figure 5-17]**
		Trimmed to 4H:1V		1) No shallow depth sloughing circle with FS<1.5 2) No local slip circle FS<1.5 3) Global stability FS of the slope soils is 1.8, above the target value of 1.5 **[see Figure 5-18]**	1) No shallow depth sloughing circle with FS<1.25 2) No local slip circle with FS<1.25 3) Global stability FS of the slope soils is 1.4, above the target value of 1.25 **[see Figure 5-19]**
Little White Oak Bayou at Enid Street Crossing	North Slope (B-23)	Existing Slope	1) No shallow depth sloughing circle with FS<1.3 at slope surface 2) No local slip circle with FS < 1.3 3) Global stability FS of the slope soils is 1.63, above the target FS of 1.3. **[see Figure 5-20]**	1) Shallow depth sloughing circle FS is 1.04, close to sloughing failure 2) Local slip circle FS is 0.91, indicating local slope failure 3) Global stability FS of the slope soils is 1.09, way below the target value of 1.5 **[see Figure 5-21]**	1) Shallow depth sloughing circle FS along slope surface is 0.61, indicating sloughing failure 2) Local slip circle FS is 0.52, indicating local slope failure 3) Global stability FS of the slope soils is 1.15, below the target value of 1.25 **[see Figure 5-22]**

Location		Slope Description	Slope Stability Factor of Safety		
			Short Term Condition (Target FS: ≥1.3)	**Long Term Condition (Target FS: ≥1.5)**	**Rapid Drawdown Condition (Target FS: ≥1.25)**
Little White Oak Bayou at Enid Street Crossing	North Slope (B-23)	Trimmed to 2H:1V			1) Shallow depth sloughing circle FS along slope surface is 1.2, slightly below the target value of 1.25 2) Local slip circle FS is 0.87, indicating local slope failure 3) Global stability FS of the slope soils is 0.96, indicating global slope failure **[see Figure 5-23]**
		Trimmed to 3H:1V			1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) Local slip circle FS is 1.35, above the target value of 1.25 3) Global stability FS of the slope soils is 1.2, below the target value of 1.25 **[see Figure 5-24]**
		Trimmed to 4H:1V		1) No shallow depth sloughing circle with FS<1.5 2) No local slip circle with FS<1.5 3) Global stability FS of the slope soils is 1.81, above the target value of 1.5 **[see Figure 5-25]**	1) No shallow depth sloughing circle with FS<1.25 along slope surface 2) No local slip circle with FS<1.25 3) Global stability FS of the slope soils is 1.44, above he target value of 1.25 **[see Figure 5-26]**

5.2.1.4.1 ***Slope Stability Discussion***

It should be noted that the presence of concrete rubble along the existing slopes (especially near the bottom of slope) can have the effects of enhancing the stability (to what degree it is uncertain) of the

surface and toe of the existing slopes. No information on past maintenance/ rehabilitation/improvements to the existing earth slopes at both these crossing is available.

Link Road Crossing

West Slope:

The existing west slope at Link Road crossing, as surveyed, has an upper slope with inclination of about 1.5H:1V to 2.57H:1V, a middle flatter plateau with inclination of about 3.6H:1V to 11H:1V, and a steep lower slope with inclination between about 0.4H:1V, with a bank-to-toe inclination of approximately 2.73H:1V.

Based on the soil stratigraphy from the soil borings and results of the stability analyses presented in Figure 5-1 through 5-6 and summarized in the preceding table, the existing west slope will experience shallow depth sloughing and/or local slope instability and/or possesses inadequate global slope stability factors of safety under long term and rapid drawdown loading conditions, the same is true when the existing slope is trimmed to a 3H:1V inclination. At a slope inclination of 4H:1V (the ultimate channel section), the west slope will possess adequate factors of safety against slope instability in the short and long term and rapid drawdown loading conditions.

East Slope:

The existing east slope at Link Road crossing, as surveyed, has an upper slope with inclination of about 1.15H:1V, a middle flatter plateau with inclination of about 3H:1V, and a lower slope with inclination of about 1.76H:1V, with a bank-to-toe inclination of approximately 2.1H:1V.

Based on the soil stratigraphy from the soil borings and results of the stability analyses presented in Figure 5-7 through 5-12 and summarized in the preceding table, the existing east slope will

experience shallow depth sloughing and/or local slope instability and/or possesses inadequate global slope stability factors of safety under long term and rapid drawdown loading conditions, the same is true when the existing slope is trimmed to a 3H:1V inclination. At a slope inclination of 4H:1V (the ultimate channel section), the east slope will possess adequate factors of safety against slope instability in the short and long term and rapid drawdown loading conditions.

Enid Road Crossing

South Slope:

The existing south slope at the Enid Street crossing, as surveyed, has inclination ranging from about 1.3H:1V to 2.3H:1V, with a bank-to-toe slope inclination of approximately 1.9H:1V.

Based on the soil stratigraphy from the soil borings and results of the stability analyses presented in Figure 5-13 through 5-19 and summarized in the preceding table, the existing south slope will experience shallow depth sloughing and/or local/global slope instability and/or possesses inadequate local/global slope stability factors of safety under long term and rapid drawdown loading conditions, the same is true when the existing slope is trimmed to a 2H:1V and 3H:1V inclination. At a slope inclination of 4H:1V (the ultimate channel section), the south slope will possess adequate factors of safety against slope instability in the short and long term and rapid drawdown loading conditions.

North Slope:

The existing north slope at the Enid Street crossing, as surveyed, has inclination ranging from about 1.11H:1V to 1.18H:1V, with a bank-to-toe slope inclination of approximately 1.16H:1V.

Based on the soil stratigraphy from the soil borings and results of the stability analyses presented in Figure 5-20 through 5-26 and summarized in the preceding table, the existing north slope will

experience shallow depth sloughing and/or local/global slope instability and/or possesses inadequate local/global slope stability factors of safety under long term and rapid drawdown loading conditions, the same is true when the existing slope is trimmed to a 2H:1V and 3H:1V inclination. At a slope inclination of 4H:1V (the ultimate channel section), the north slope will possess adequate factors of safety against slope instability in the short and long term and rapid drawdown loading conditions.

5.2.1.5 Protection of Slope Soils

ATL understands that no modification to the existing earth slopes is planned for the proposed water line and aerial crossing construction; however, some incidental construction excavations that are small and localized in area may occur during the water line installation and bridge foundation construction at the ditch crossing. If repair/restoration of the existing slopes is required due to incidental excavation or disturbance incidental to the aerial crossing construction, ATL recommends that the existing earth slopes is restored to no steeper than the existing slope, and to a flatter slope wherever feasible. Existing retaining walls and other structural components of the bridge should not be disturbed.

According to the crumb and pinhole tests, some of the on-site clay soils are slightly dispersive to dispersive. ***If any of the existing trees/vegetation/structures that provides protection and cover to the existing earth slopes and/or any part of the existing earth slopes have been excavated in the process of construction of the proposed water line aerial crossing***, one or a combination of the following measures should be carried out to mitigate the erosion potential and protect the earth slopes:

1. Use non-dispersive select fill meeting requirements specified in Section 5.2.1.5 as construction backfill involved in the water line construction within 50 feet of the banks of the channel, and any slope excavation or modification.

2. If dispersive soils such as sands or silts or low plasticity clays were exposed at the surface of the trimmed or modified slopes, place a minimum 2-foot thick clay liner to protect the surface soils from potential erosion and piping failure due to seepage.
3. Protect the exposed slope surface immediately after trimming and/or modifying the slopes by sodding, seeding or hydro-mulching, in accordance with 2005 HCFCD Standard Specifications Book Section 02921 and referenced sections. Sodding can provide the prepared slope surface with immediate erosion protection. If seeding or hydro-mulcing is carried out, the slope surface and the seeding should be protected by erosion blankets, turf mats or other geo-fabric while the vegetation is establishing. A combination of strip sodding and seeding or hydro-mulching may also be implemented.
4. The earth slopes should be monitored and inspected periodically for signs of sloughing and/or erosion. Any sloughing/erosion of the slope soils should be promptly repaired to mitigate its propagation to ensure long term stability of the earth slopes.

5.2.1.5 Select Fill for Clay Liner and Slope Construction

The select fill for use as clay liner and as fill material for the slope construction should be non-dispersive sandy lean clay or lean clay (pinhole test classification ND-1 or ND-2), with a LL less than 50, a PI between 15 and 30, and the percent passing a No. 200 sieve between 60 and 85 (Section 02314 of 2005 HCFCD Standard Specifications Book). The select fill should be placed in loose lifts not exceeding 8 inches in thickness. Heavy compaction equipment and excessive equipment passes should be avoided within 3 feet of the culverts or other existing structures. Backfill within 3 feet of culverts/structures should be placed in loose lifts no more than 4 inches thick and compacted using portable compaction equipment such as hand tampers, etc. The fill should be compacted to a minimum 95% of the ASTM D-698 maximum dry unit weight and at moisture content within optimum and 3% wet of optimum.

5.2.2 Water Line Aerial Crossing Foundation Supports

The proposed water line alignments along Link Road and Enid Street will cross the Little White Oak Bayou and the depth of the bayou at the crossings is approximately 26 to 28 feet deep.

Link Road Crossing

The aerial crossing at Link Road will be supported on the existing bridge deck. The proposed water line aerial crossing and its structural components that are to be supported by the existing Link Road bridge are anticipated to impose only a small fraction of the design capacity of the existing bridge foundation.

Enid Street Crossing

The aerial crossing at Enid Street are proposed to be supported on seven 12-inch square concrete piles; the pile tip elevation will be adjusted for ultimate channel section and load capacity considerations. Based on the plan and profile drawing, the proposed 12-inch square concrete piles (Bent 1 through 7, see Figure 10b) will be located at approximately Station No. 2+28, 2+48, 2+68, 2+88, 3+33, 3+53 and 3+73. ***However, ATL recommends 16-inch square concrete piles instead of 12-inch for the reasons that they will provide more rigidity and hence will be more robust to sustain pile driving stresses.***

5.2.2.1 Axial Load Capacity

Enid Street Aerial Crossing Pile Foundations

Soil information from Borings B-22 and B-23 were used to develop foundation recommendations for the 16-inch square concrete pile foundations for the proposed water line aerial crossing.

Based on the slope stability analyses of the earth slopes at the Enid Street crossing, the ultimate channel slope at 4H:1V is found to possess adequate factors of safety against short and long term and rapid drawdown loading conditions. Therefore, the ultimate channel slope at 4H:1V was assumed to develop the pile capacity analyses (i.e., soils above 4H:1V slope will be neglected).

In our pile capacity analyses, we also neglected the bearing capacity of the top 10 feet of the slope and channel bottom soils to account for potential effects of weathering, erosion/sloughing and incidental excavations, etc. A Factor of Safety of 2.0 and 3.0 is typically applied to the skin friction and end bearing, respectively. No skin friction reduction factor was applied in the skin friction capacity computation for the driven piles.

Pile Capacity Curves: The computed allowable axial capacity curves (compression and uplift) for a 16-inch square concrete pile at location of Bent 1 through 7 are presented on Plates 6-1 through 6-7 in Appendix 6. The allowable compression capacity typically includes both the allowable end bearing as well as the skin friction capacity; the allowable uplift (tension) capacity includes only the allowable skin friction capacity. However, TxDOT recommends that disregarding end bearing capacity for piles with widths less than 24 inches. Thus, end bearing capacity of the 16-inch square piles are disregarded, and hence the allowable compression capacity is the same as the allowable tension (uplift) capacity.

5.2.2.2 Pile Spacing

To mitigate the influence of adjacent piles and group effects, edge-to-edge spacing between adjacent piles should not be less than 3 feet, and the minimum center-to-center spacing between adjacent piles should be at least 3 times the width of the larger pile. The minimum spacing must include proper allowances for tolerance of vertical alignment.

5.2.2.3 Foundation Construction

It is essential that installation of the concrete piles should not impose significant additional loading or relieve stresses that can adversely impact existing foundations/structures. Existing concrete rubble, if found at pile locations, will have to be removed to facilitate the pile driving. Pilot hole shall only be used when it is necessary due to obstructions; if pilot hole is excavated, temporary casing is recommended to protect existing earth slopes, retaining walls, bridge structure, utilities and other structures.

ATL recommends that the 16-inch square concrete pile material and installation should be in accordance with applicable sections of the Harris County Public Infrastructure Department (HCPID) Standard Specifications Item No. 405 and 410, and Texas Department of Transportation (TxDOT) "2004 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", Item 409 "Prestressed Concrete Piling".

5.3 Pavement Repair or Replacement

Any street cut necessary for this project should be restored to its original condition using material similar in nature and thickness to the existing streets. Recommendations outlined in City of Houston Standard Specification, Section 02951 – Pavement Repair and Resurfacing should be followed. The top 8 inches of the subgrade soils in the pavement repair areas should be stabilized. ATL recommends stabilizing subgrade clay soils with plasticity indices above 15 and above 25 with at least 6 and 7 percent lime, respectively, and stabilizing granular soils and clay soils with plasticity indices of less than 15 with at least 4 percent lime and 8 percent fly ash, on weight basis; optimum amount of stabilization shall be determined by conducting laboratory testing.

The lime and lime-fly ash stabilization should be carried out in accordance with City of Houston Standard Specifications Section 02336 and 02337, respectively.

6.0 CONSTRUCTION CONSIDERATION

The proposed water line installation will involve mostly trenchless construction techniques and some open cut/trenching construction. Accordingly, most of the water line installation excavation will likely be advanced in firm to hard clay soils. However, water line installation excavation at/near Borings B-17 and B-20 (but not limited to) will likely extend into silty sands (SM).

Based on the proposed invert elevation and the groundwater information gathered during our field investigation, the water line construction excavations at/near Borings B-17 and B-20 (but not limited to) will likely encounter groundwater; groundwater may also be encountered in some of the excavations exceeding about 5 feet that remains open for more than 24 hours. It should be noted that groundwater level will fluctuate with the amount of precipitation and the prevailing environmental conditions prior to and during construction.

For water line installation excavation advanced in clay soils, the seepage rates are usually low, and groundwater control can usually be controlled by sumping and pumping. However, for excavations advanced in water-bearing sands/silts stratum (not encountered in our soil borings, but may be present away from our soil borings), where water inflow rate is high, dewatering using well points will be required to provide a dry working platform and to prevent soil boiling.

The majority of the water line will be installed in firm to hard clays, in which case the excavation face are anticipated to be stable. However, water line installation excavation at/near Borings B-17 and B-20 (but not limited to) will likely to extend into silty sands (SM). Excavation face in granular soils (sand/silt/gravel), soils with only slight plasticity and other caving soils, will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, mitigating measures as discussed in Section 5.7 of this report can be employed to improve the excavation stability.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the proposed water line by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew experienced at working with the selected trenchless construction technique in subsurface conditions similar to those found in along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

6.1 Quality Control

Associated Testing Laboratories, Inc. (ATL) recommends implementation of a comprehensive quality control program under the supervision of a Professional Engineer due to the fact that a considerable amount of excavation and back filling may be required in the proposed project area. Structural integrity and stability is particularly dependent on quality foundation installation, bedding and subgrade preparations. An independent testing laboratory should be assigned to test and inspect construction materials during the construction phase.

To ensure that excavation will remain stable, to provide sufficient headroom for working, to provide worker's safety and to protect adjacent structures, the excavations will have to be provided with sufficient side slopes or shored in accordance with OSHA "Trench Safety Systems" (29 CFR Part 1926), as published in the Federal Register, Vol. 52, No.72, Section 1926-650 through 1926-653. Excavation of the trenches and access pits should be carried out under the supervision of an experienced construction supervisor and necessary shoring and/or bracing of the trenches should be properly installed. In temporary braced or shored excavations and in access pits where the sheeting terminates at the base of the trench, lateral earth pressure, surcharge, and seepage pressure caused by a differential hydrostatic head moving upward to the bottom of the trench can cause trench bottom instability. Therefore, it is recommended that, if the bottom stability evaluation yields a factor of safety less than 1.5, the sheeting should be extended below the base of cut. Before filling operations take place, representative samples of the proposed fill material should be tested by an independent

laboratory to determine the compaction and classification characteristics.

6.2 Monitoring

Despite the thoroughness of this geotechnical exploration, there is always the possibility that actual subsurface conditions may differ from the predicted conditions because conditions between soil borings can be different from those at specific boring locations.

Any excessive ground movements like settlement and lateral movement should be monitored and controlled. This can be done by performing a preconstruction survey including photography and documentation of existing conditions like elevations, cracks, etc., and by installing ground movement monitoring devices such as inclinometers, crack monitors, and establishing elevation monitor stations along the waterline alignment to monitor the ground movement after commencement of the excavation.

Associated Testing Laboratory, Inc. (ATL) recommends a regular inspection and overall project monitoring by a geotechnical engineer during the construction phase. The purpose of inspection is to provide sound engineering and judgment alternatives during construction, if unanticipated conditions occur.

7.0 LIMITATIONS

The information, findings and recommendations contained in this report are based on data obtained from test borings at the locations shown in Figures 2a through 2q, a reasonable volume of laboratory tests, and professional interpretation and evaluation of the field and laboratory data, and consideration of the project information furnished. Should it become apparent during construction that soil conditions differ significantly from those discussed in this report, this office should be notified immediately so that further evaluation and any necessary adjustments can be made.

8.0 ***REFERENCES***

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9. Annual Book of ASTM Standards for Soils and Rock; Building Stones.
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12. Groundwater Quality in Texas; Texas Natural Resources Conservation Commission.
13. CFR PART 1926.

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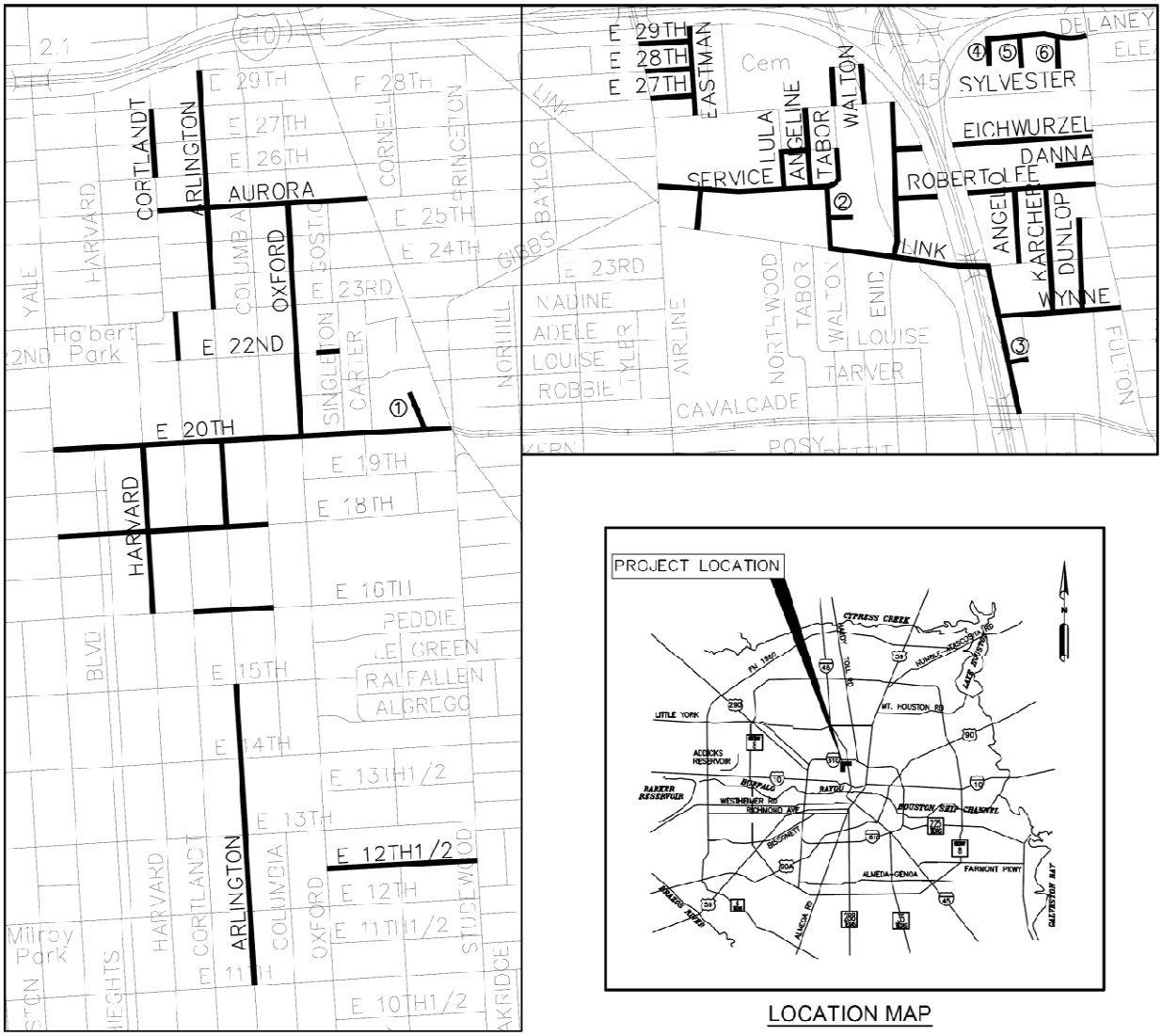


INNER LOOP NORTH AREA

PROJECT LOCATION

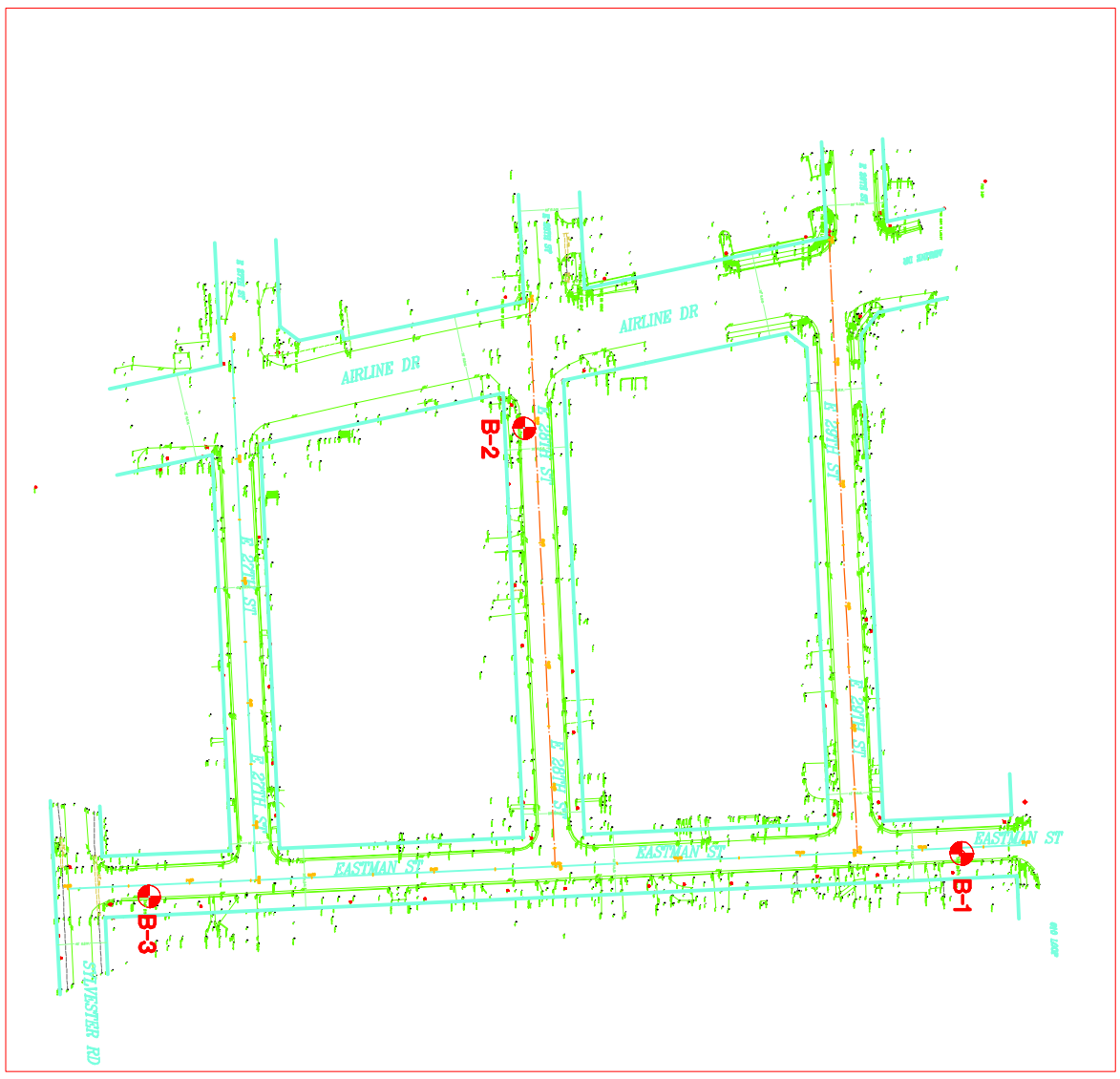
KEY MAP NO.: 453 N,P,Q,S,T,U&W

GIMS MAP NO.: 5359B&D

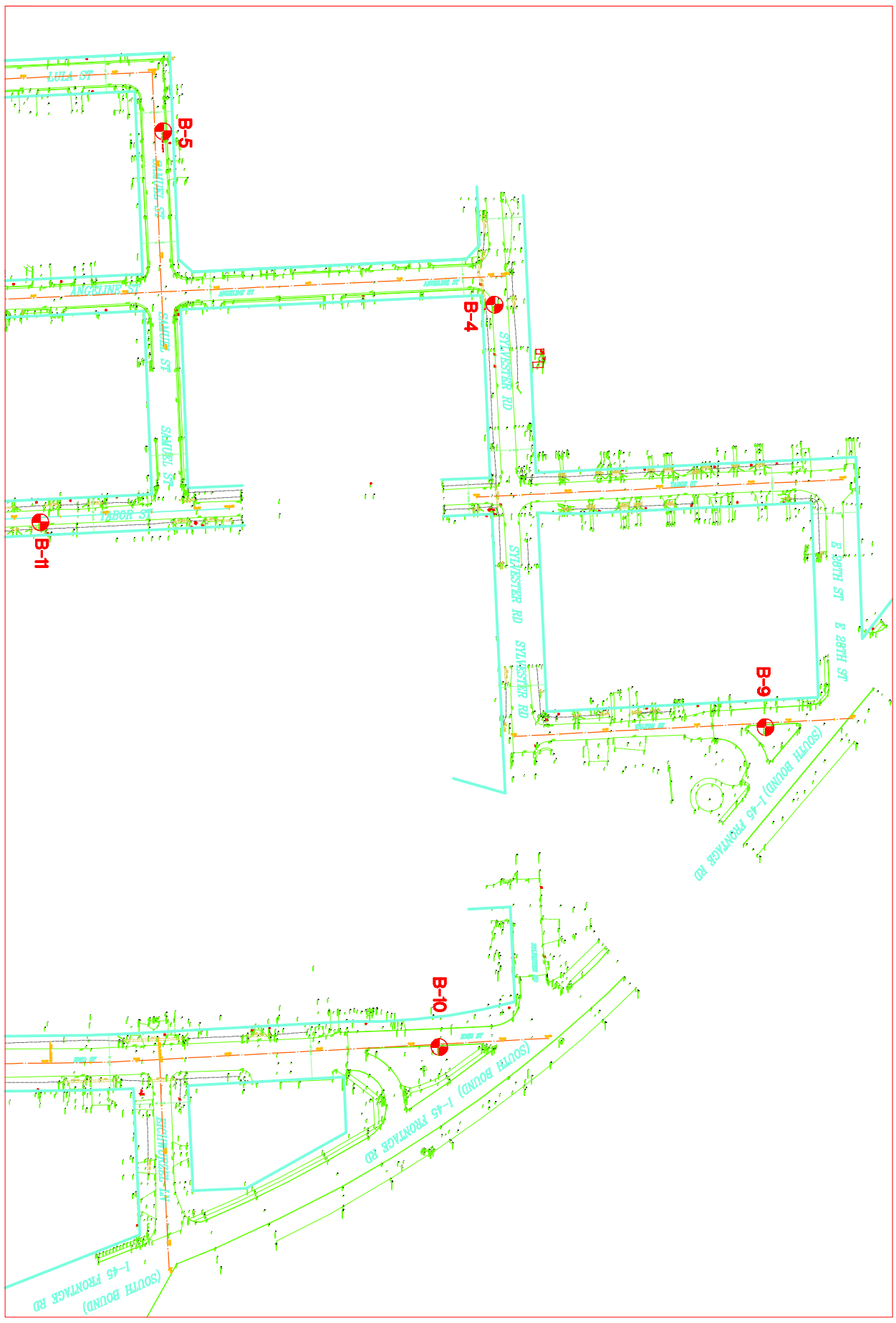
LOCATION MAP

SITE VICINITY MAP	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-000035-0182-3
	PROJECT NO. : G13-120 / FIGURE 1

PST 8/28/12



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN	WBS No.: S-000035-0182-3	SCALE: 1"= 150'
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2a



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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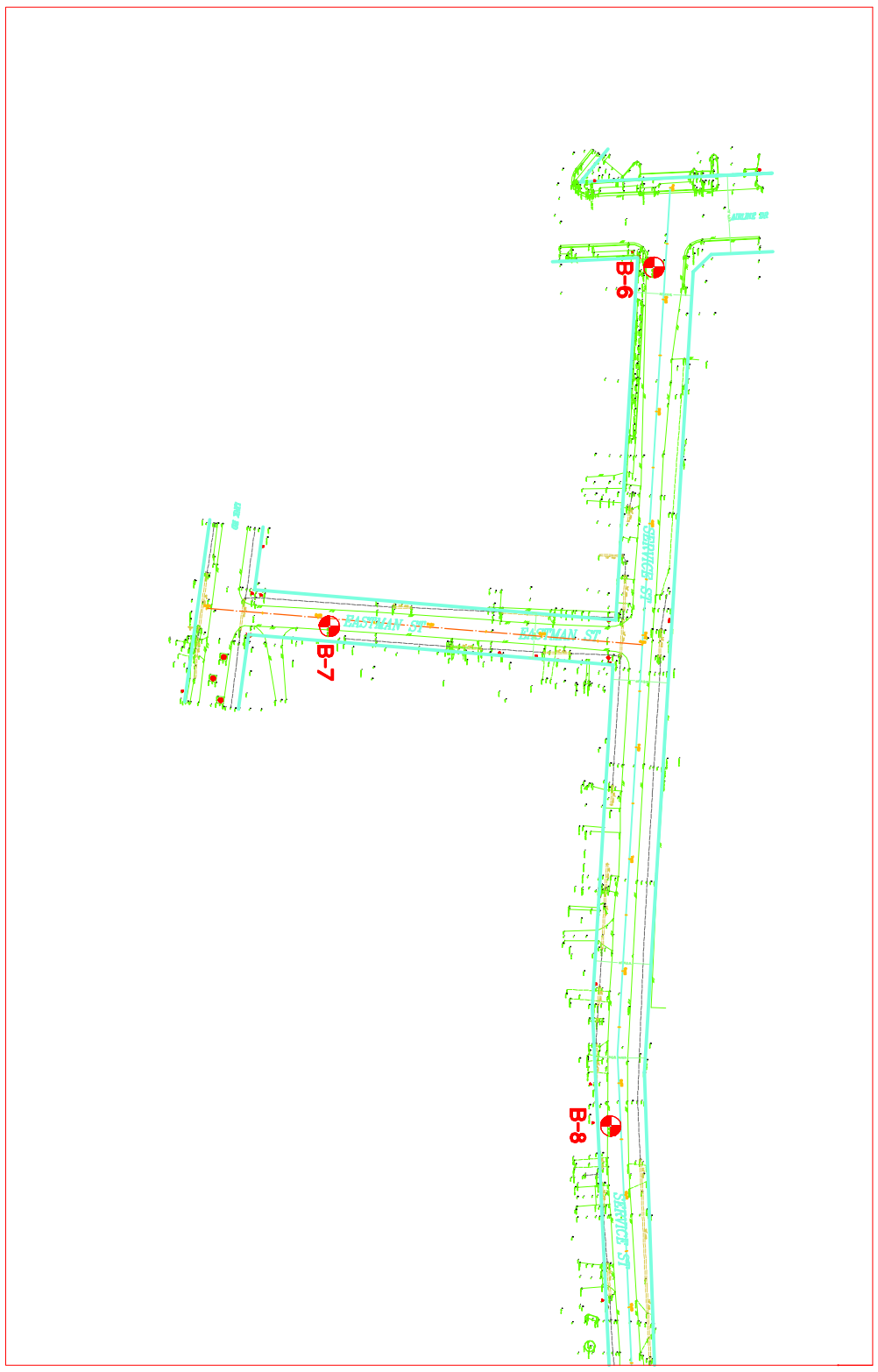
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2b



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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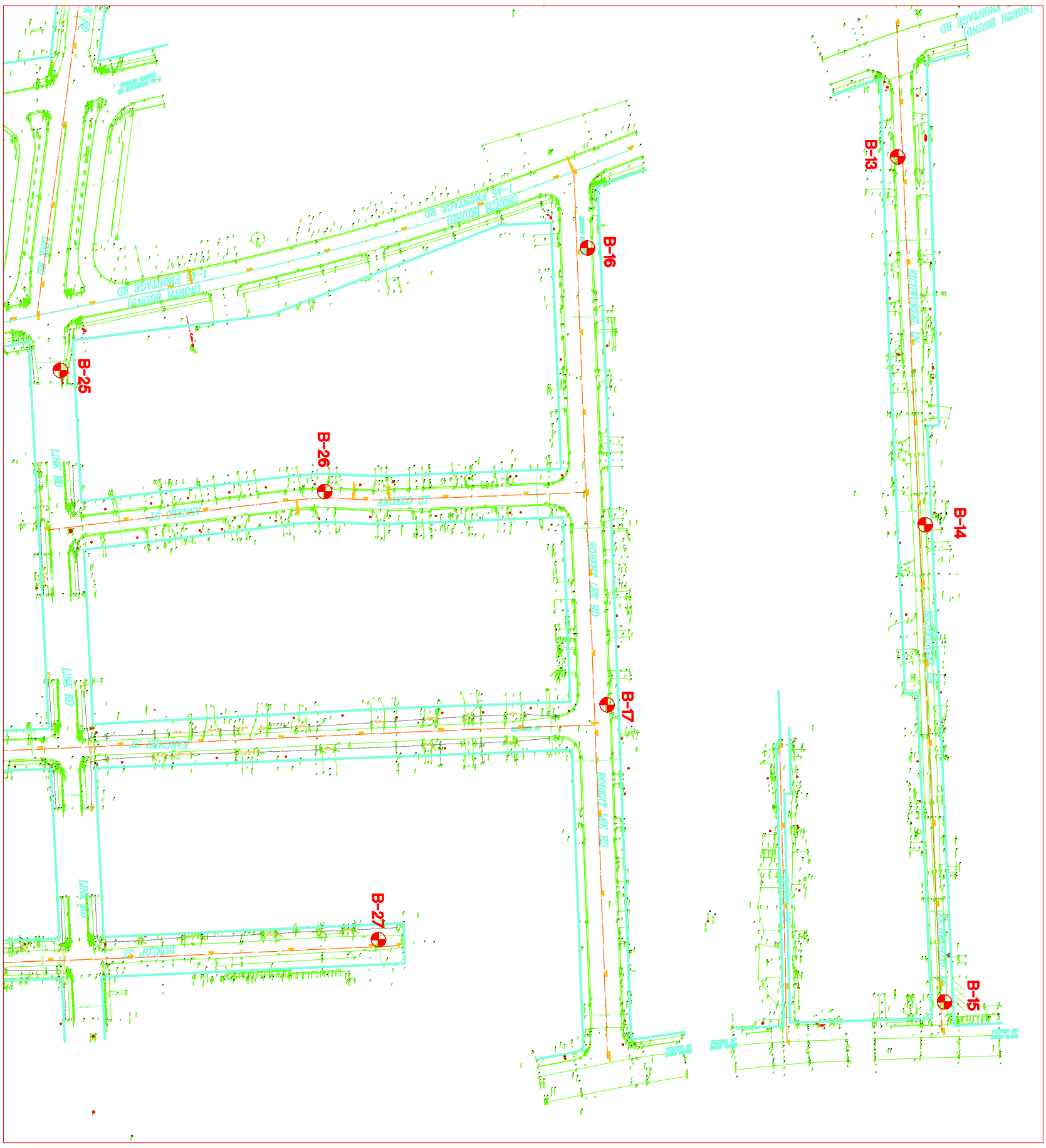
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2c



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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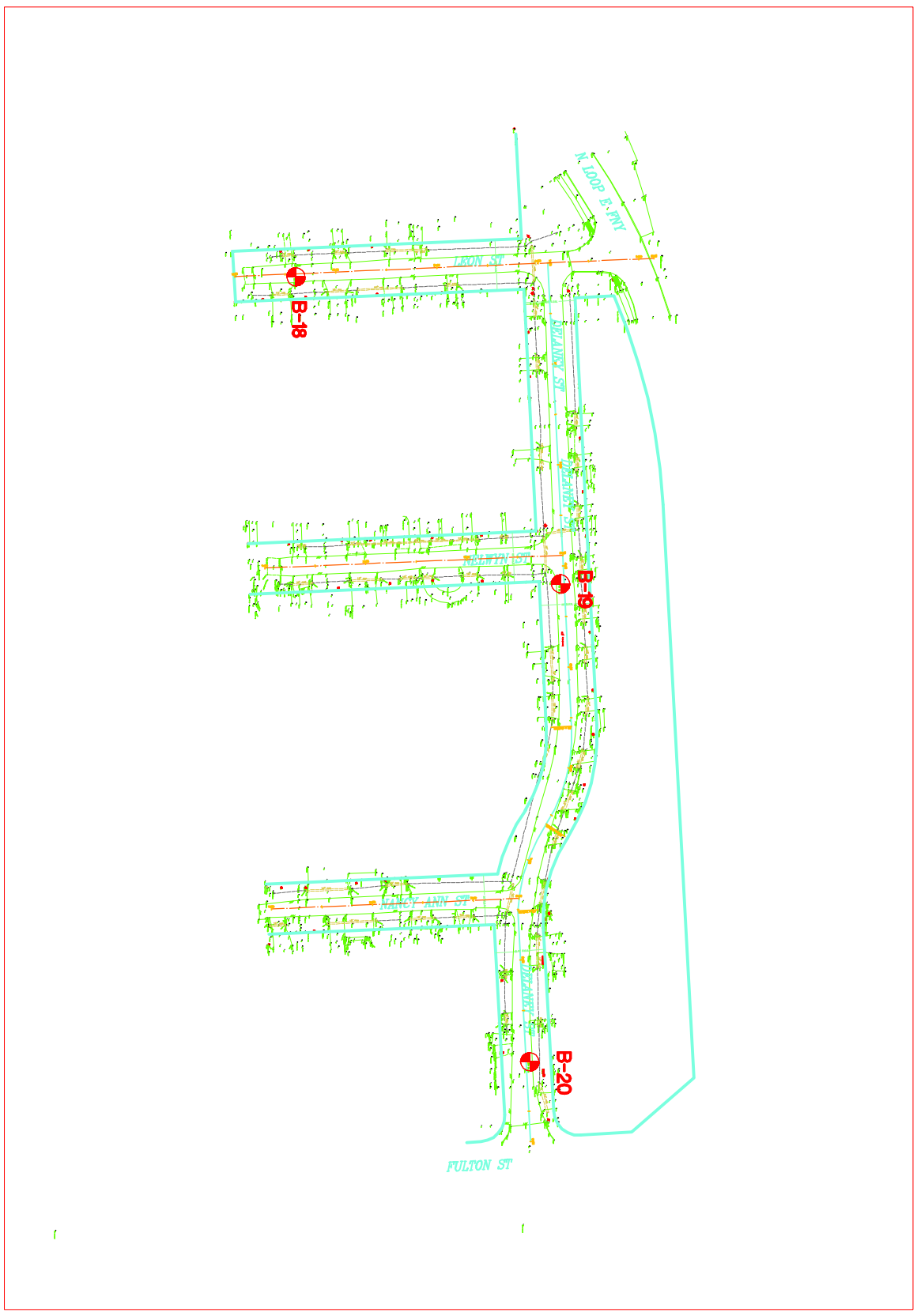
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2d



LOCATION OF BORINGS

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd. Houston, Texas
Tel: (713) 748-3717 Fax: (713) 748-3748

WATER LINE REPLACEMENT IN

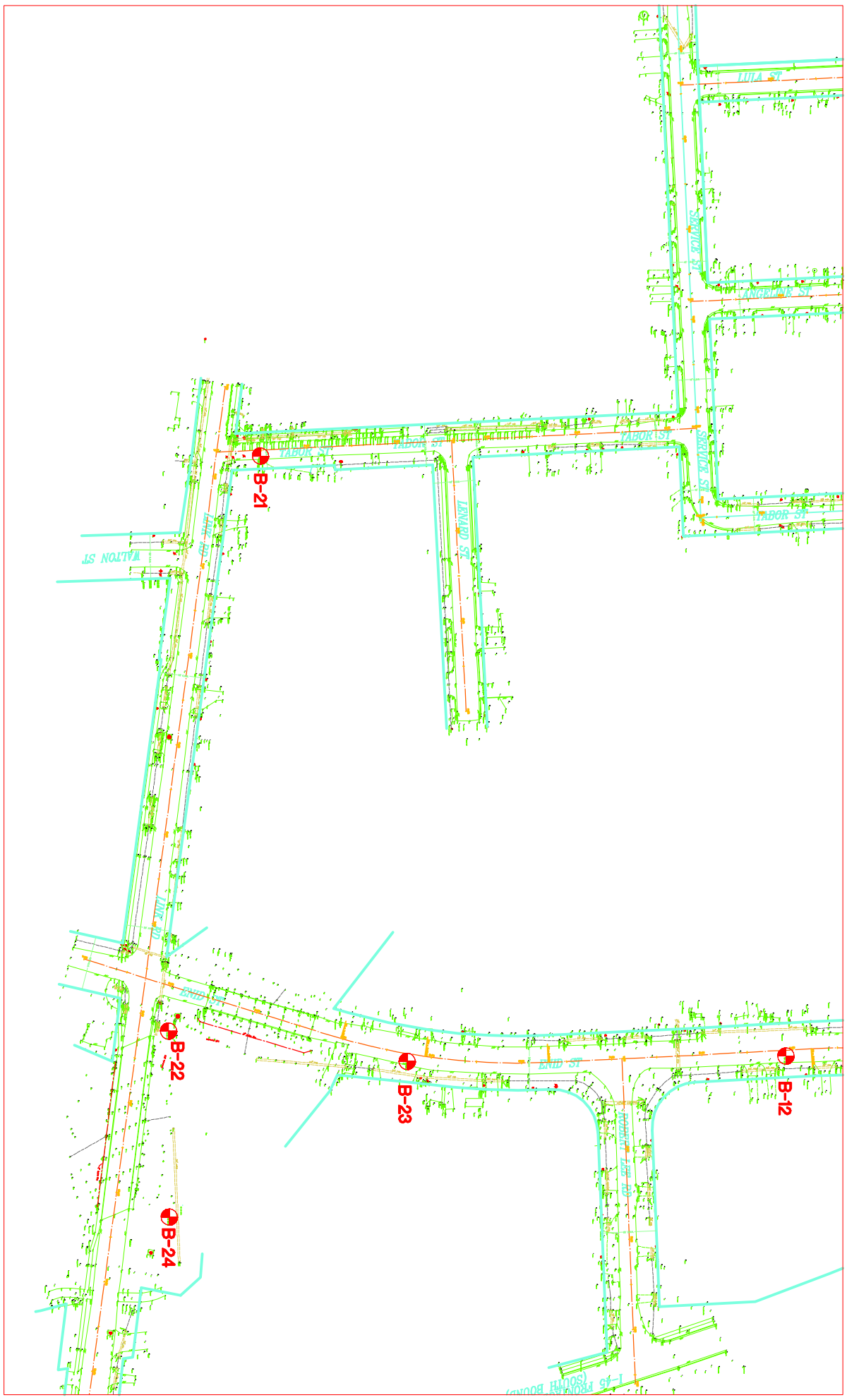
INNER LOOP NORTH AREA

WBS No.: S-000035-0182-3

PROJECT NO. G12-120

SCALE: 1'= 150'

FIGURE. 2e



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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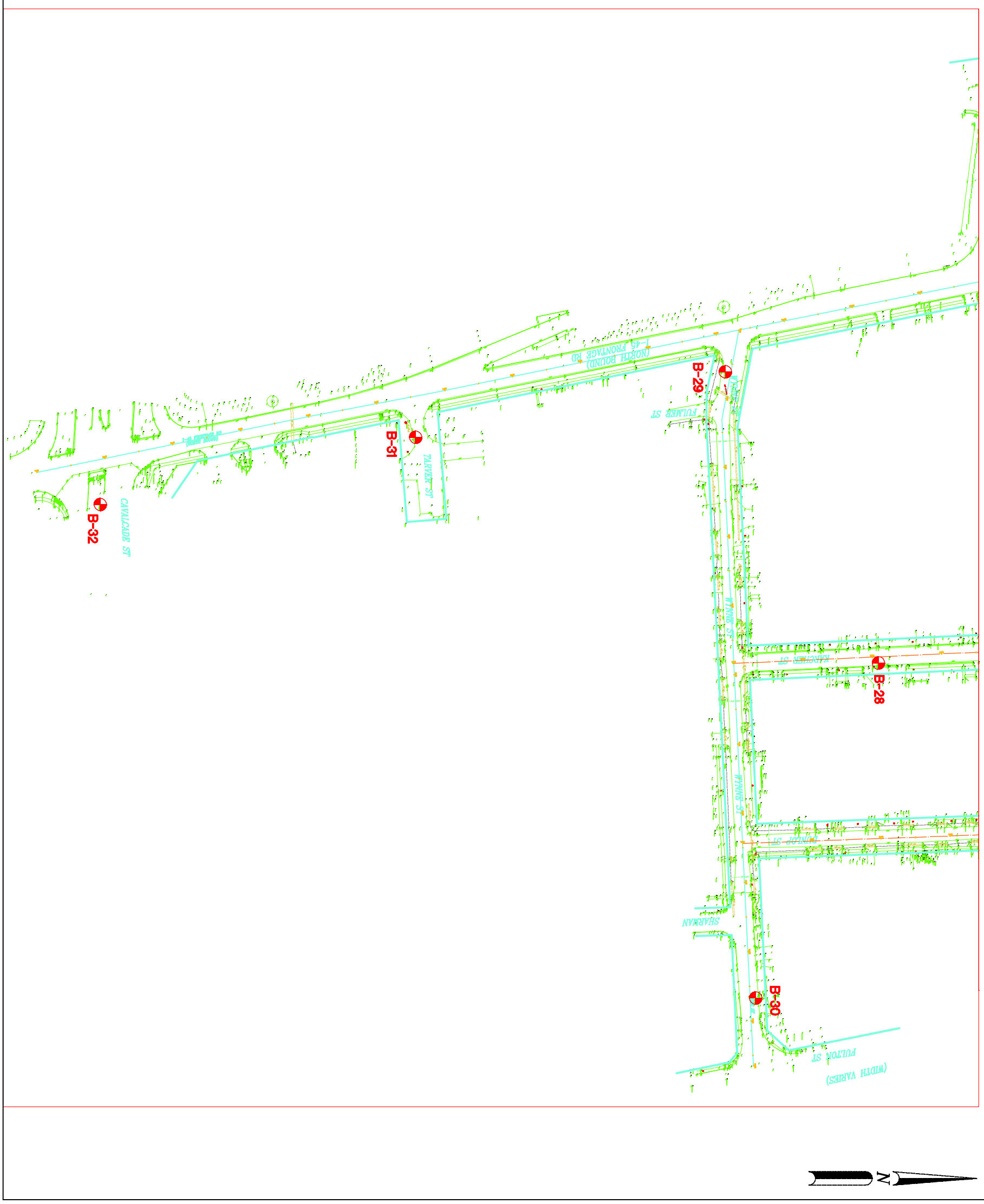
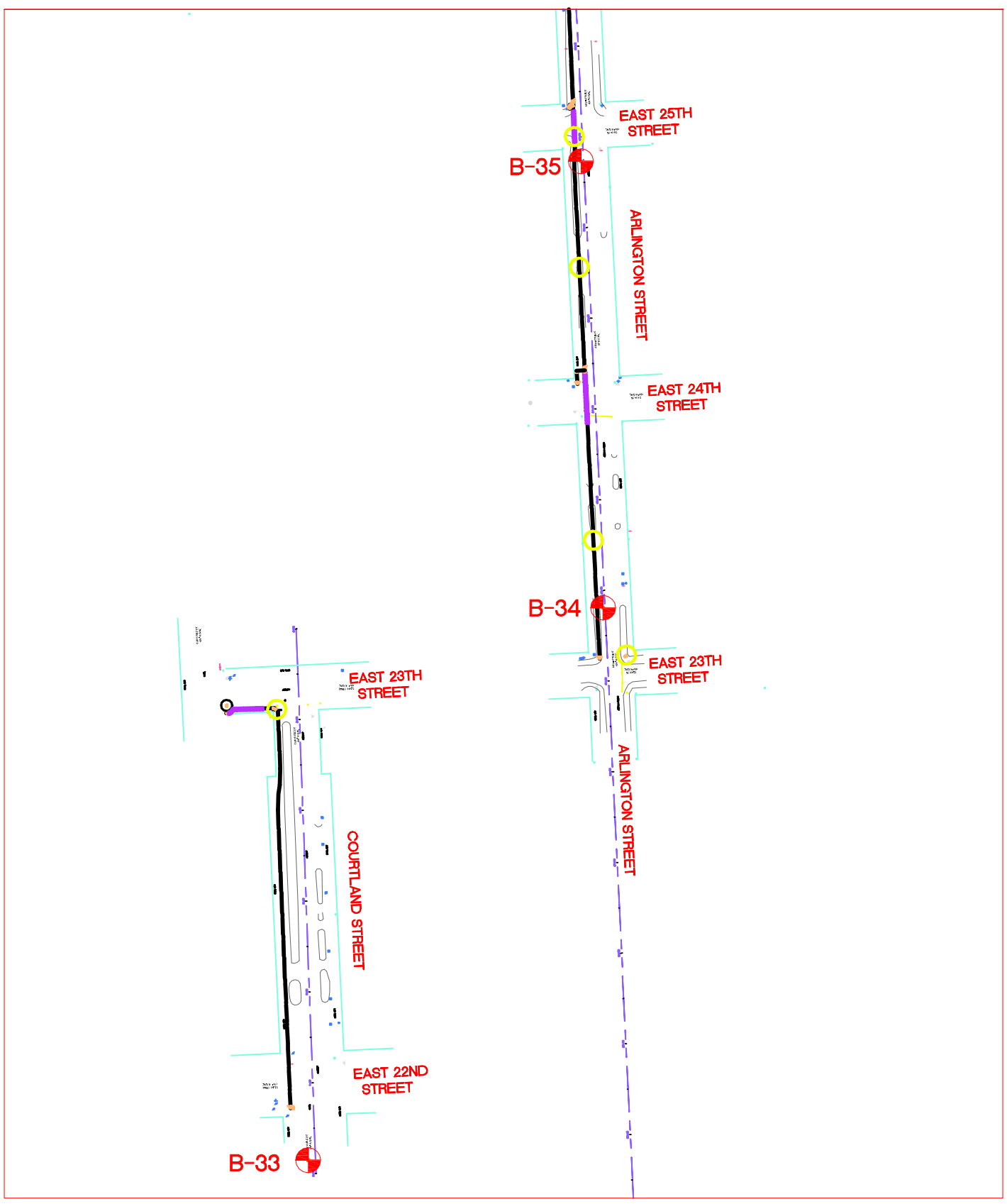
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2f



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN	WBS No.: S-000035-0182-3	SCALE: 1"= 150'
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2g



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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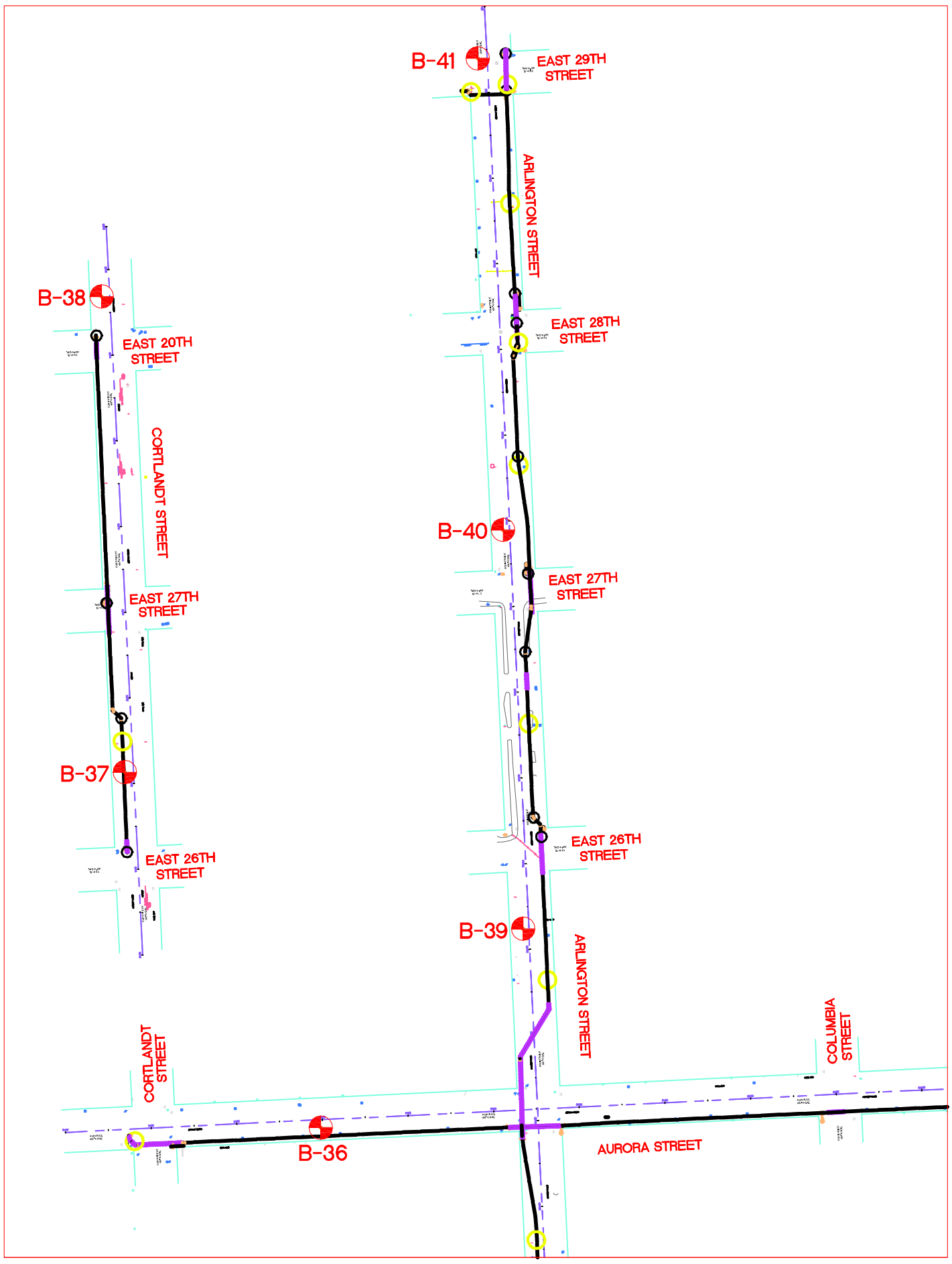
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2h



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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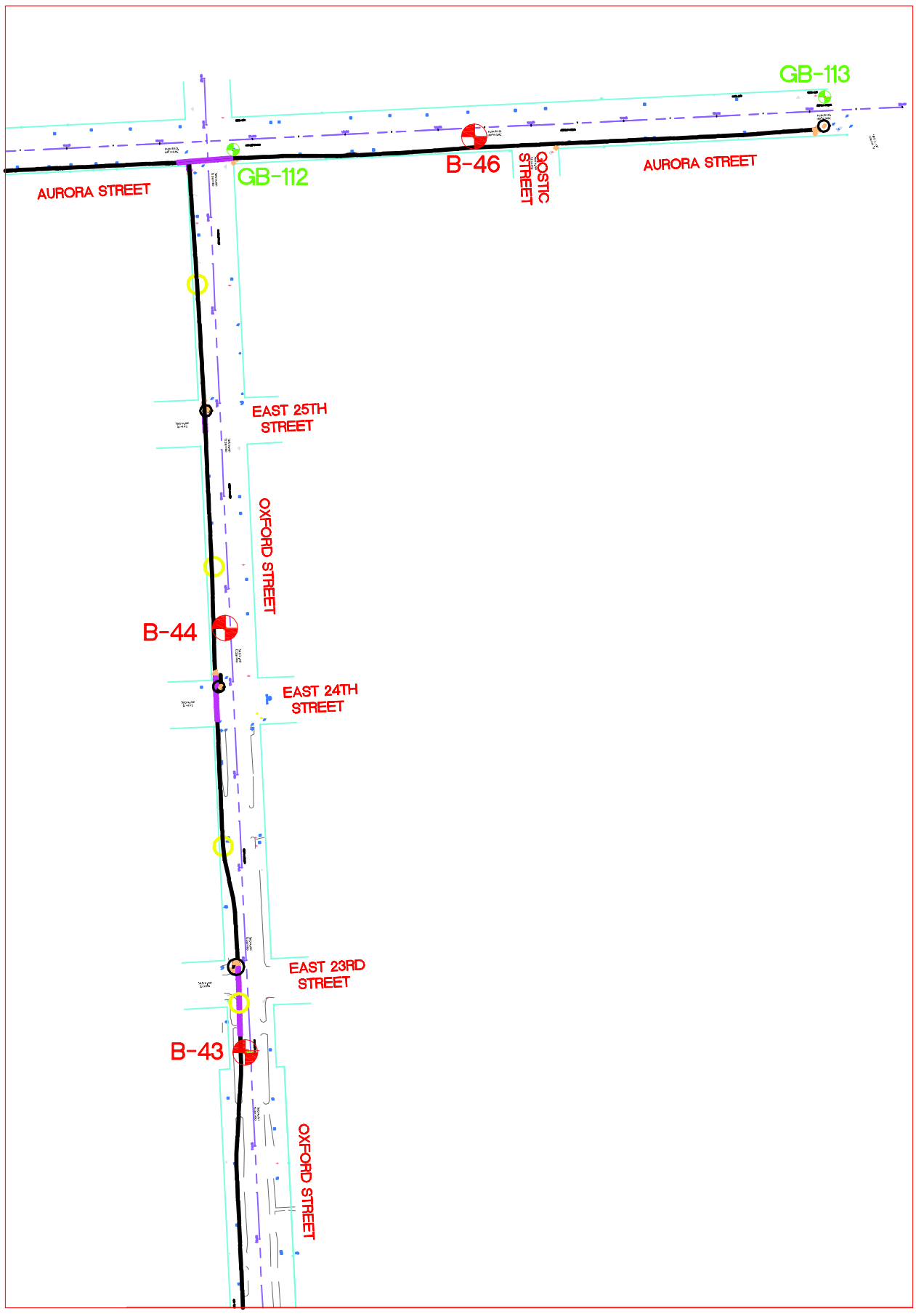
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2i



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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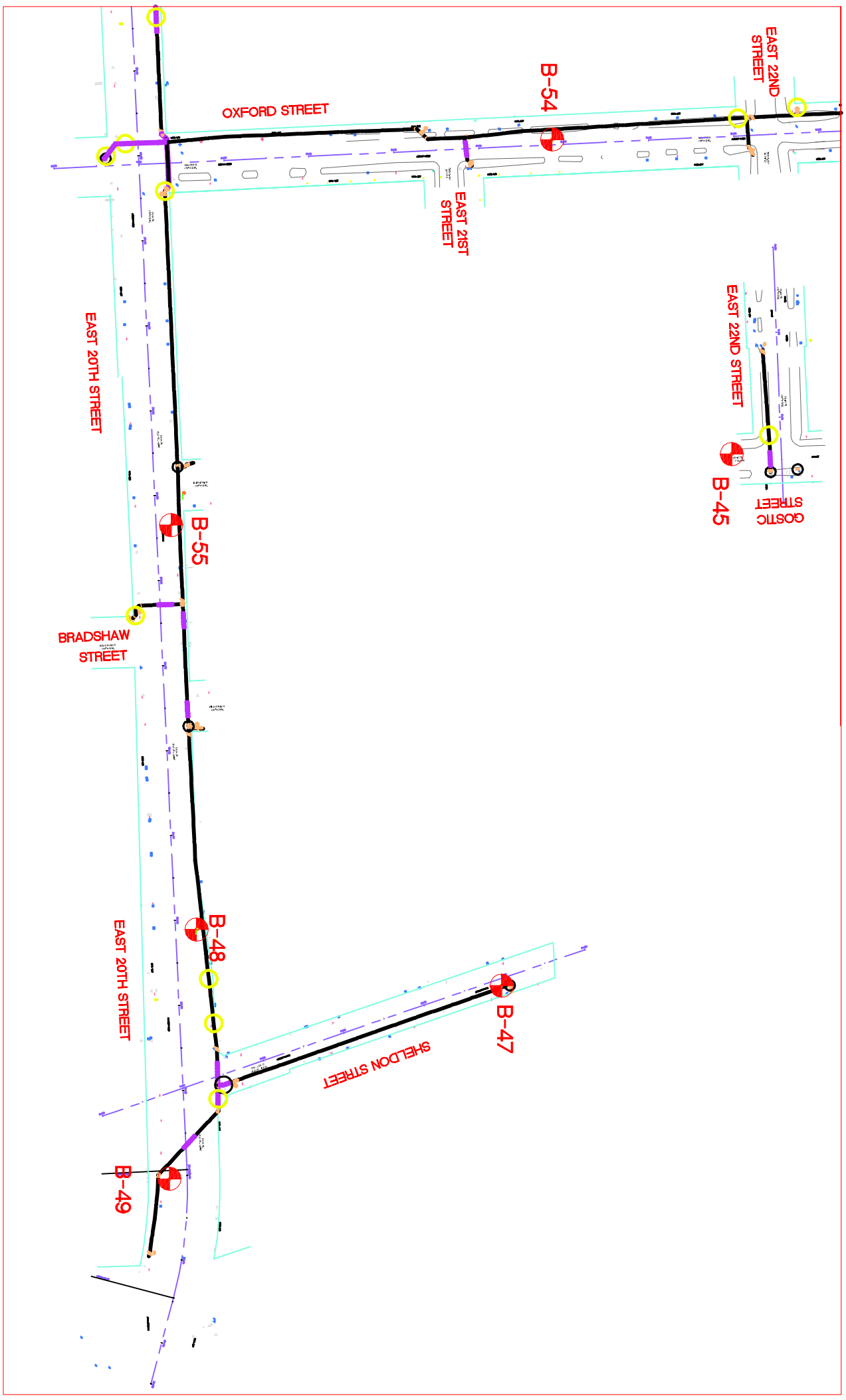
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2j



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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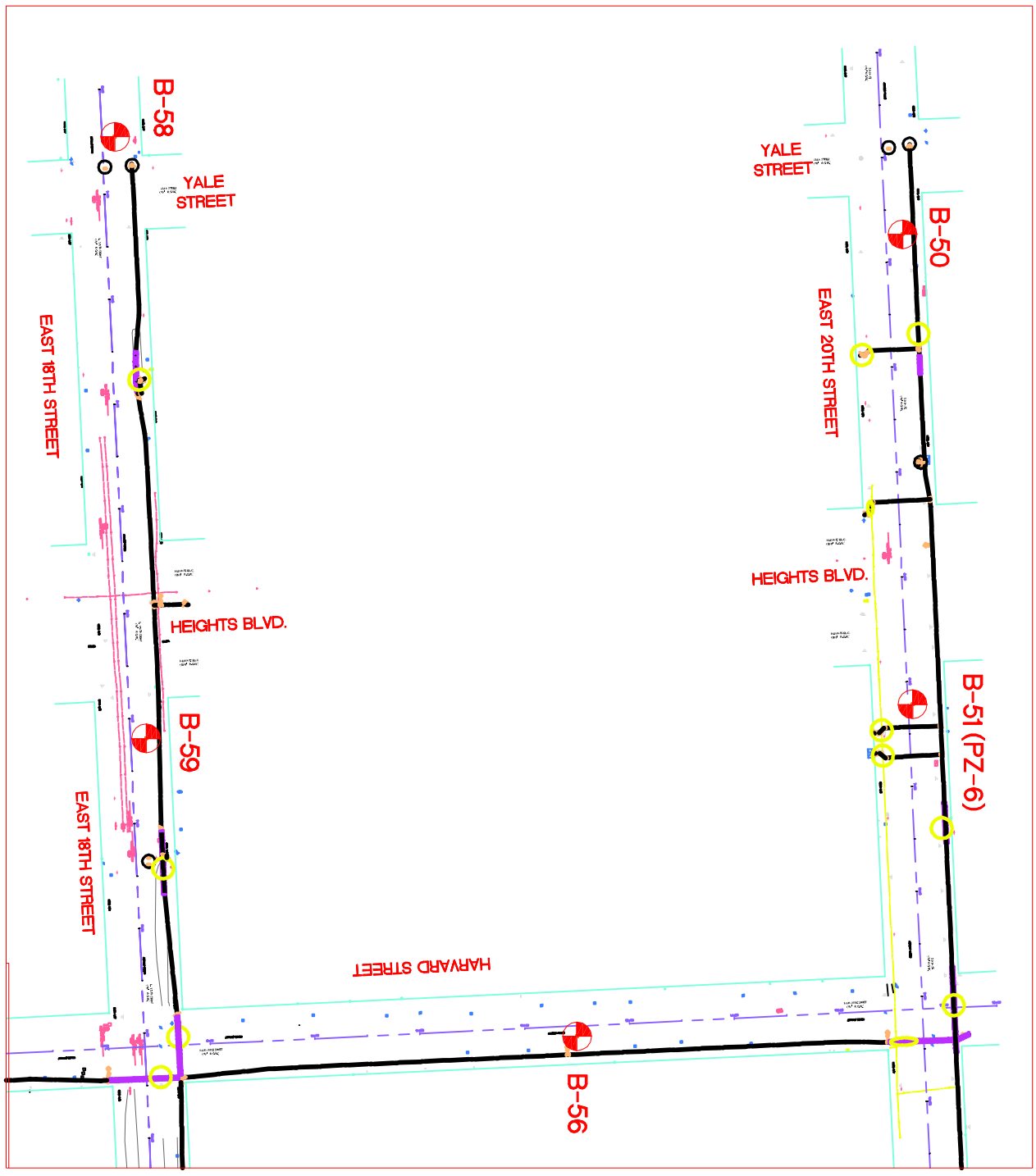
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2k



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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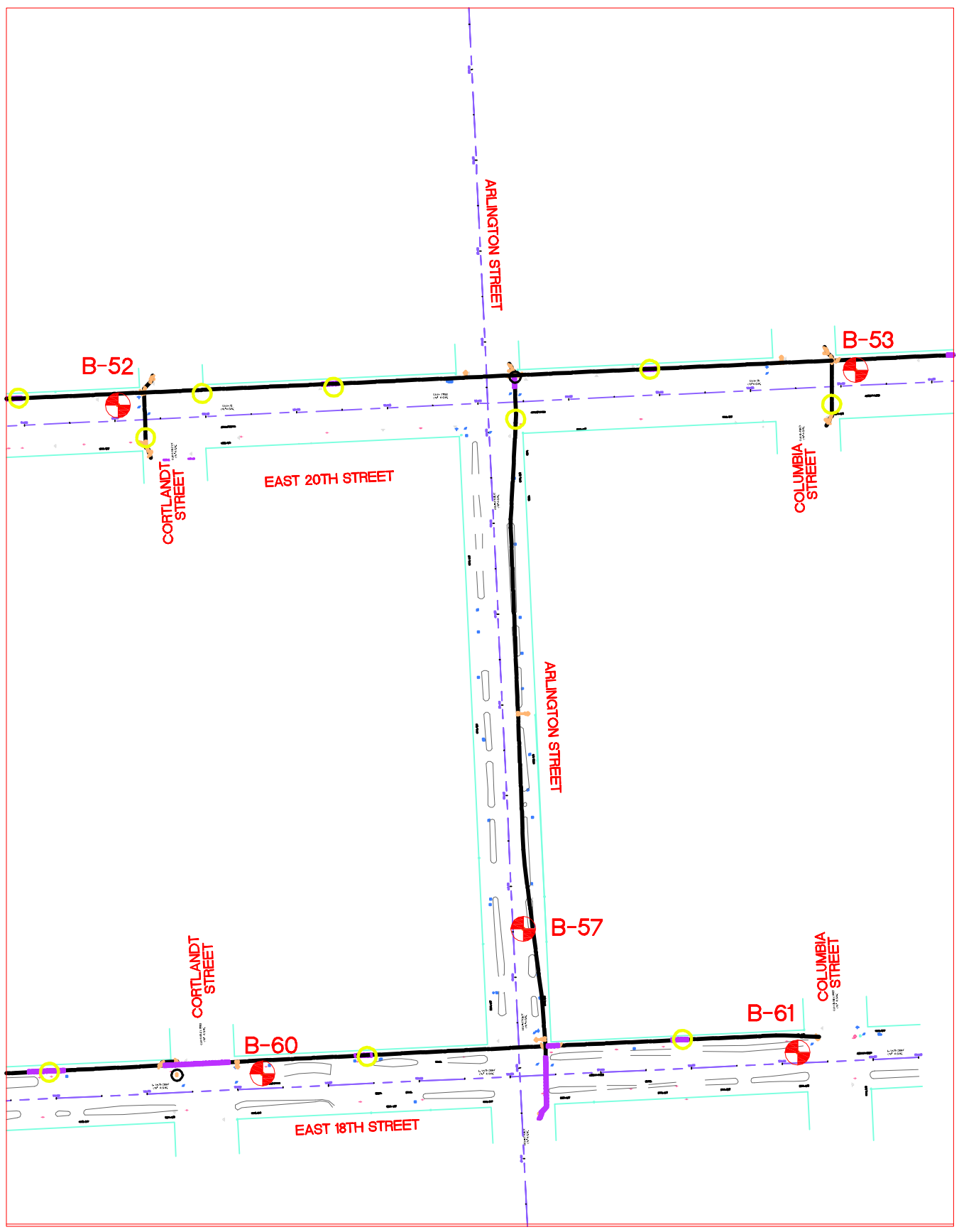
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 21



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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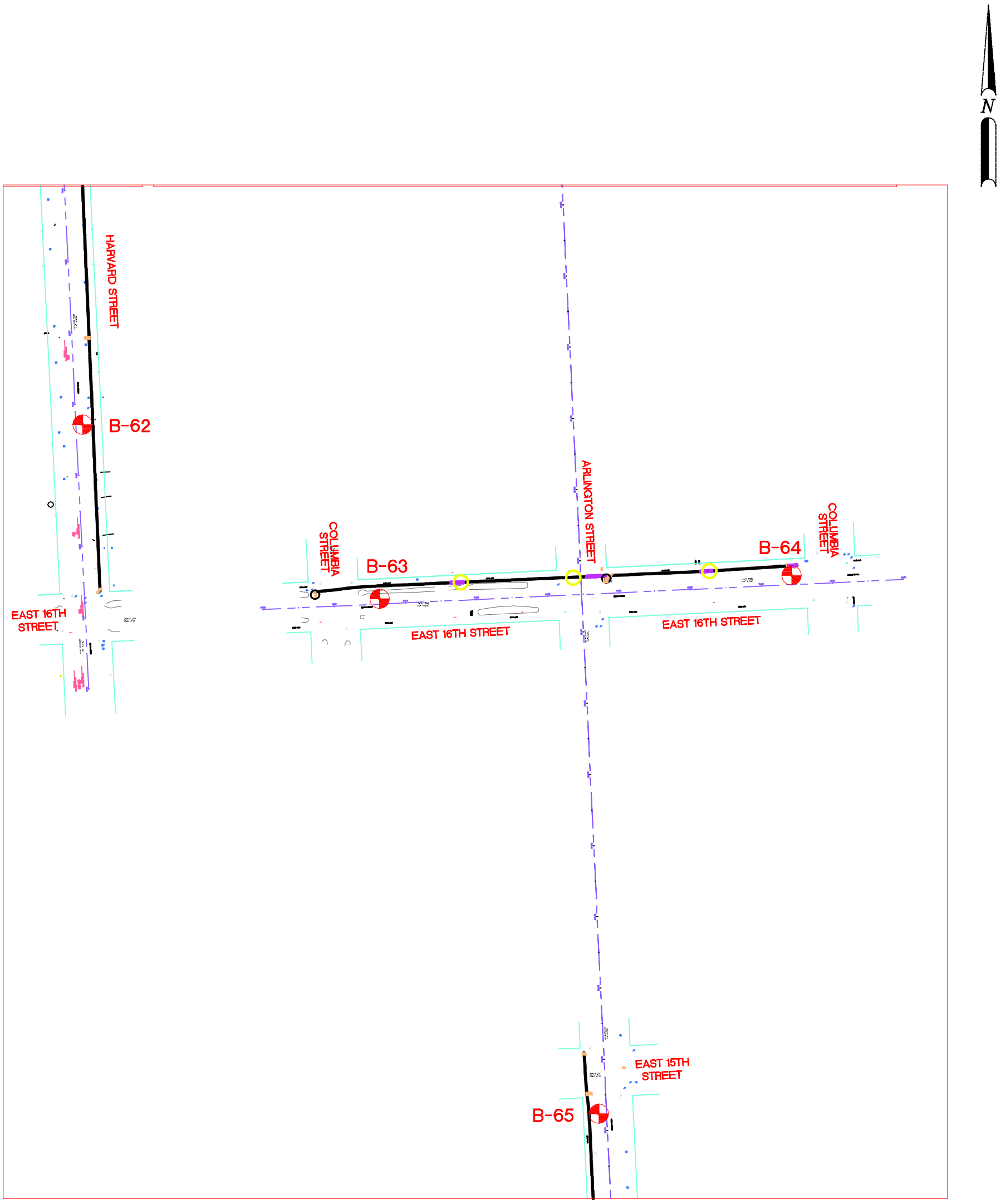
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2m



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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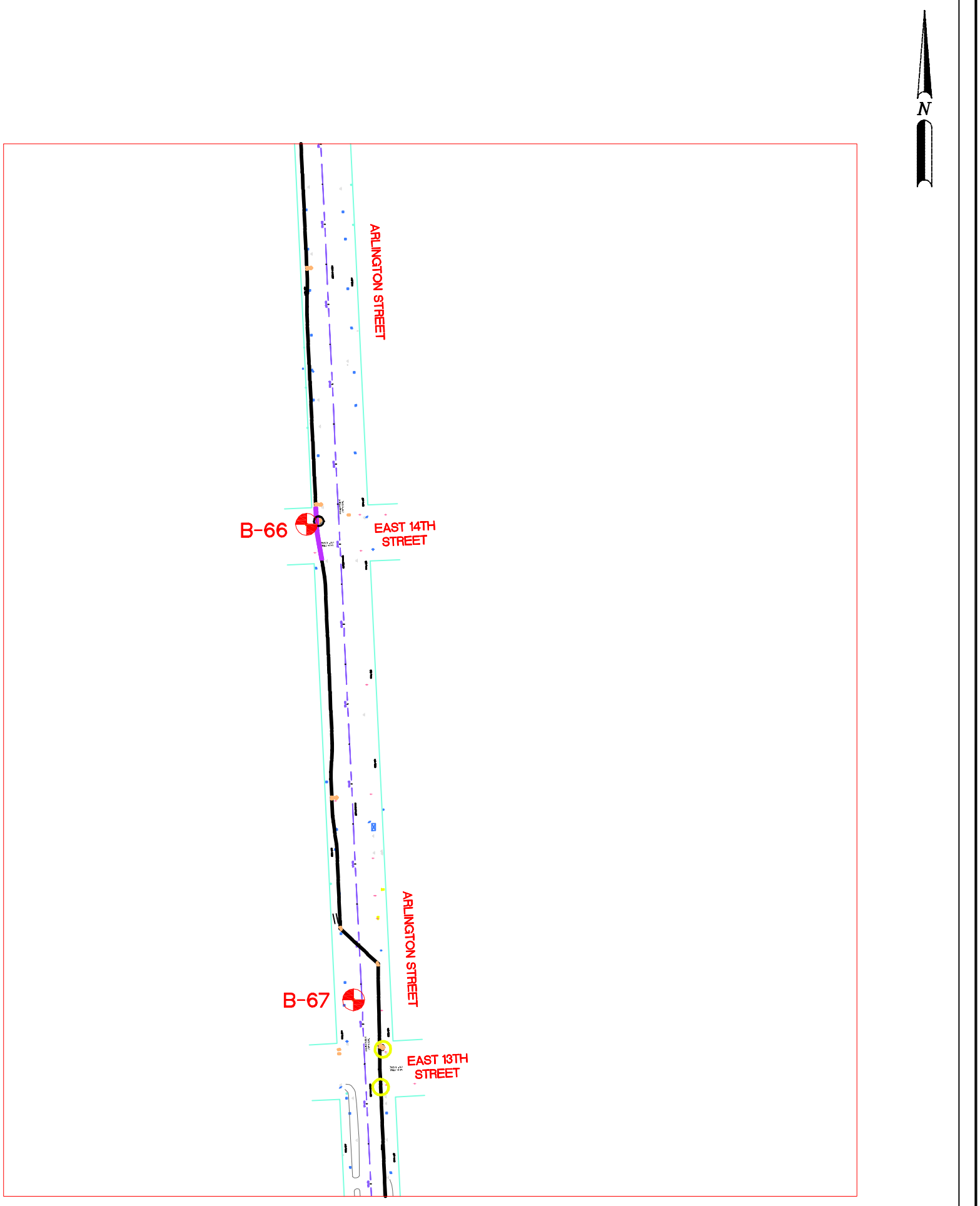
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2n



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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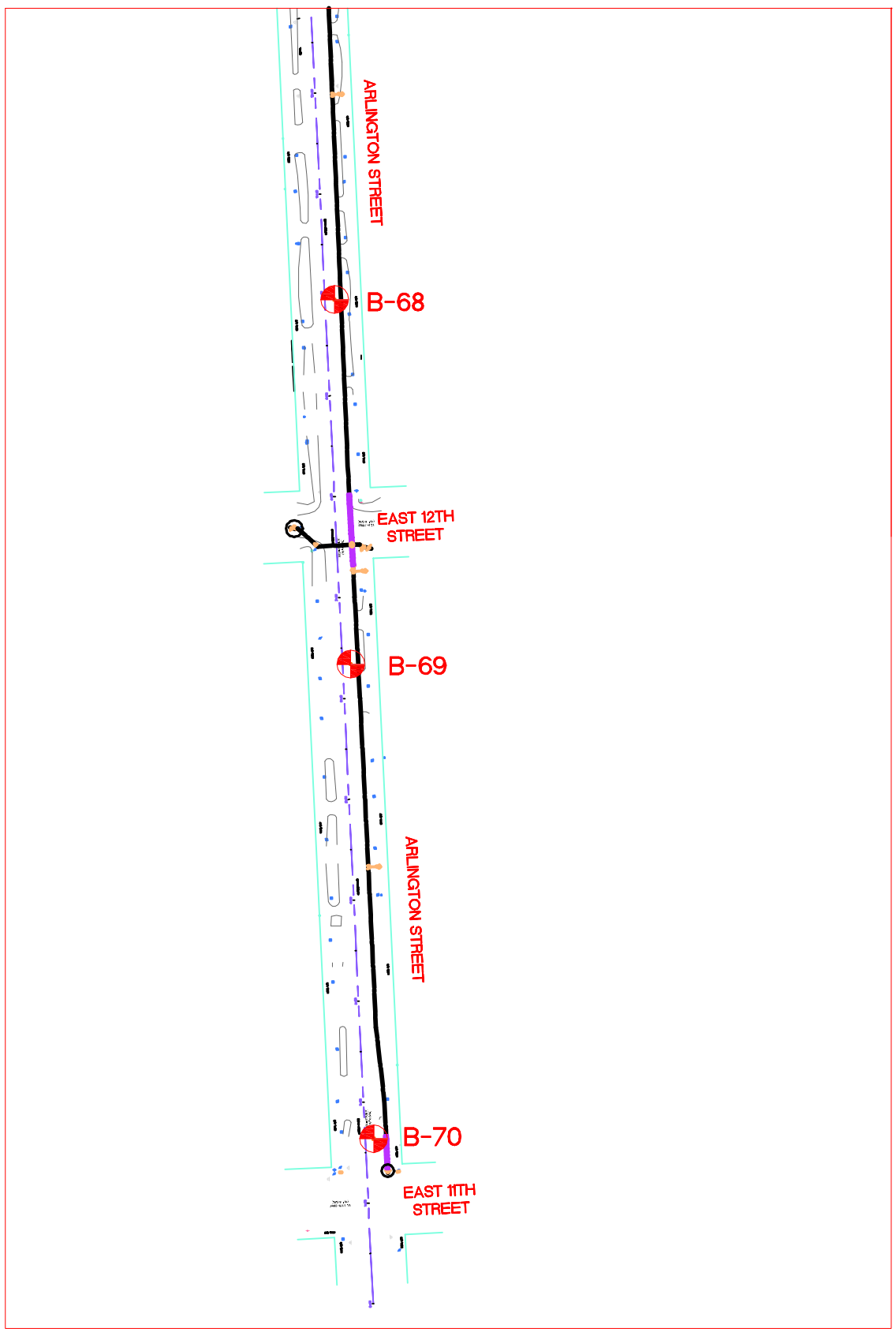
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2o



LOCATION OF BORINGS	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
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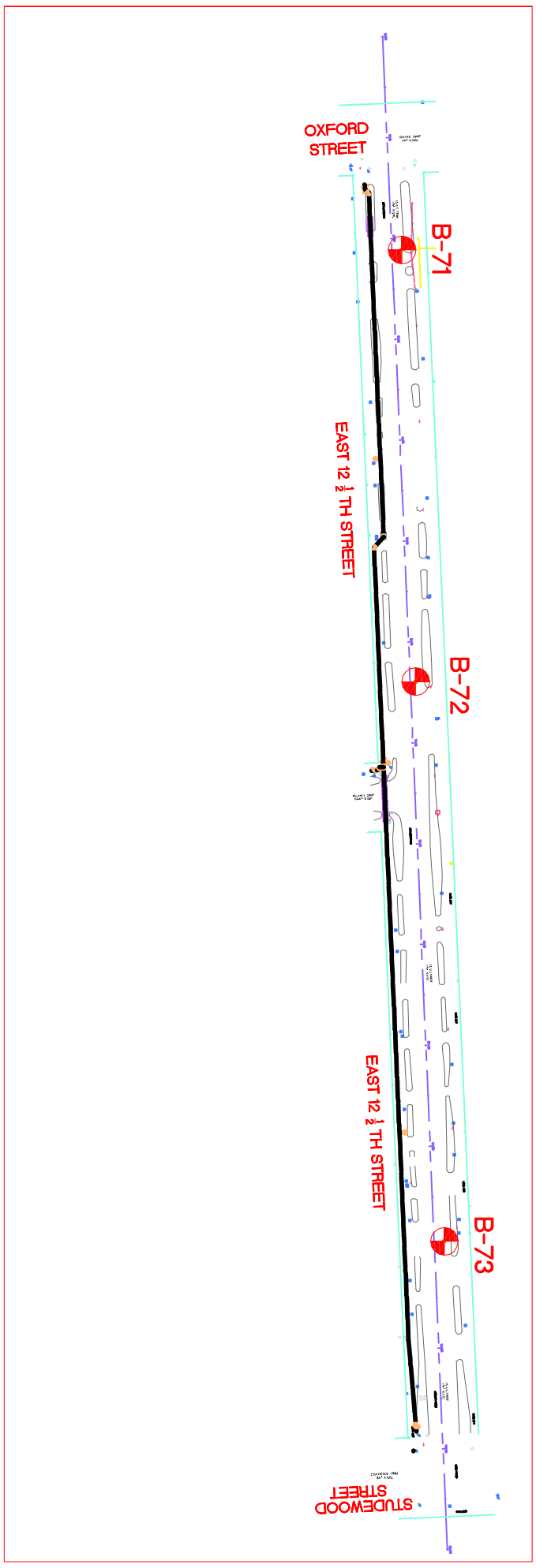
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2p

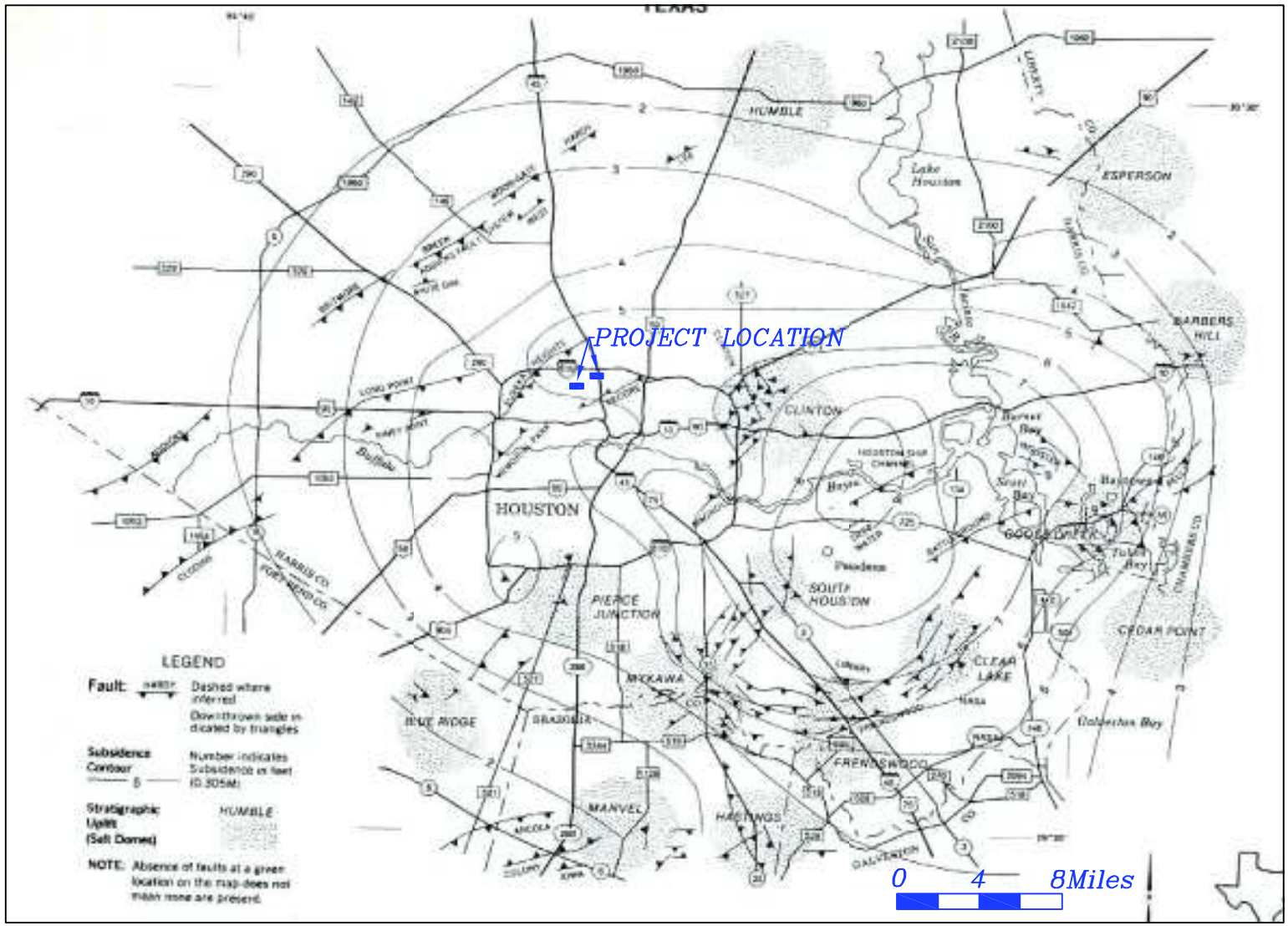


N

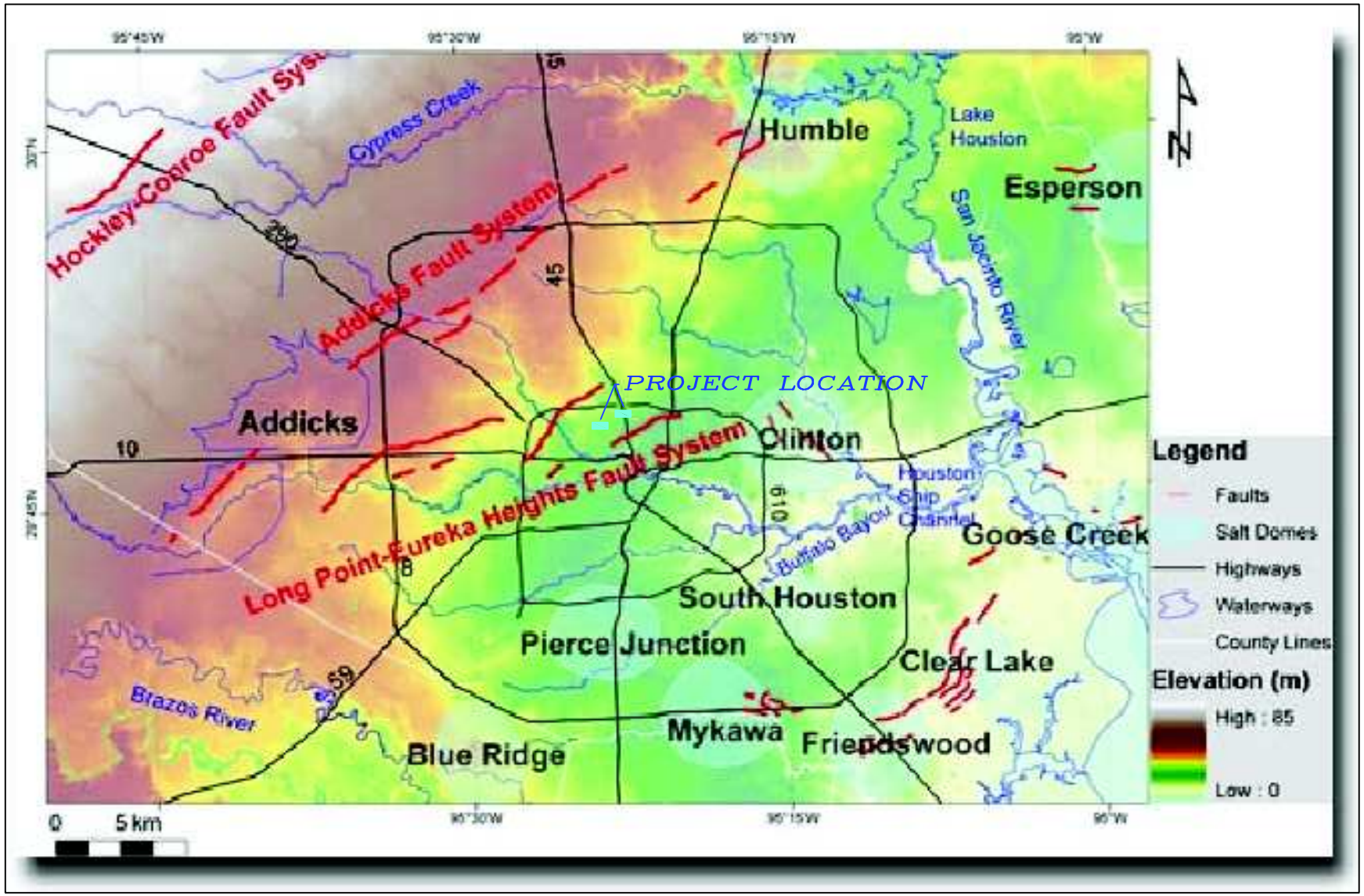
LOCATION OF BORINGS

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd. Houston, Texas
Tel: (713) 748-3717 Fax: (713) 748-3748

WATER LINE REPLACEMENT IN	WBS No.: S-000035-0182-3	SCALE: 1"= 150'
INNER LOOP NORTH AREA	PROJECT NO. G12-120	FIGURE. 2q



PRINCIPAL ACTIVE FAULTS IN HOUSTON AREA	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS No.: S-000035-0182-3	
	PROJECT NO. G13-120	FIGURE. 3a

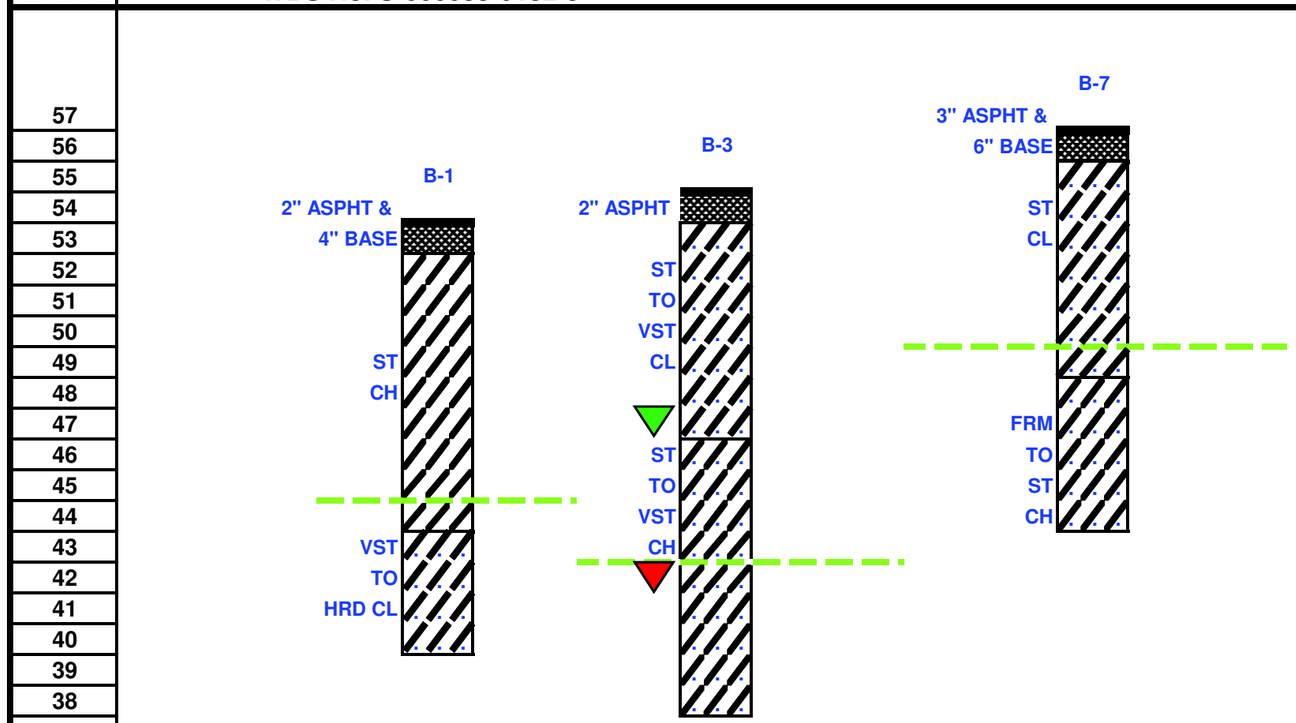


ACTIVE SURFACE FAULTS ON LIDAR IMAGERY	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS No.: S-000035-0182-3
	PROJECT NO. G13-120 — FIGURE. 3b

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-**

WBS No. S-000035-0182-3



PROFILE ALONG EASTMAN STREET

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

24 hr. Water Level

PZ Water Level (3-14-13)

PZ Water Level (4-10-13)

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

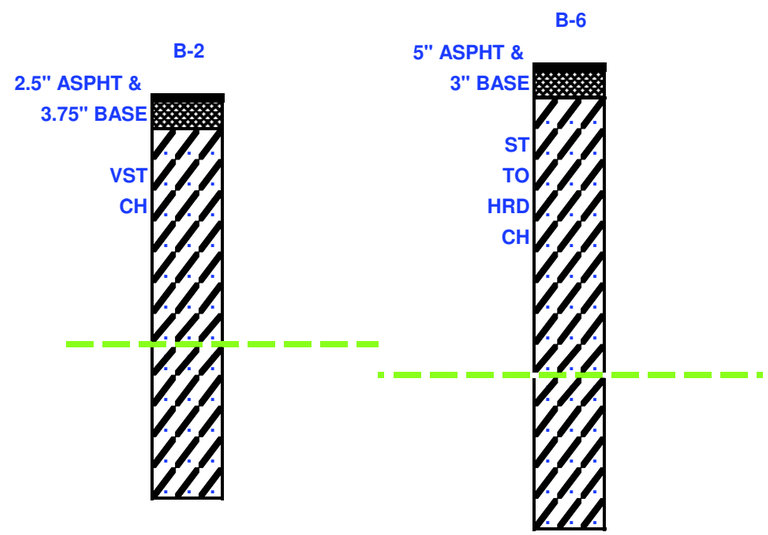
Vertical: 1"= 5'

Figure-4a

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

Elevation **WBS No. S-000035-0182-3**



PROFILE ALONG AIRLINE DRIVE

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

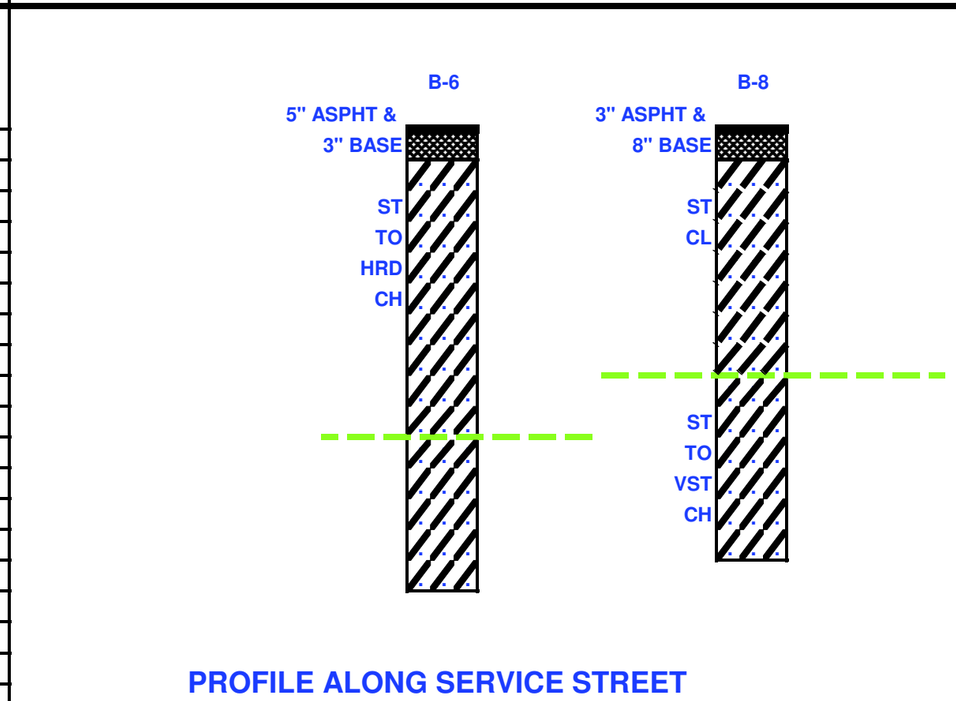
Vertical: 1"= 5'

Figure-4b

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

WBS No. S-000035-0182-3



PROFILE ALONG SERVICE STREET

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

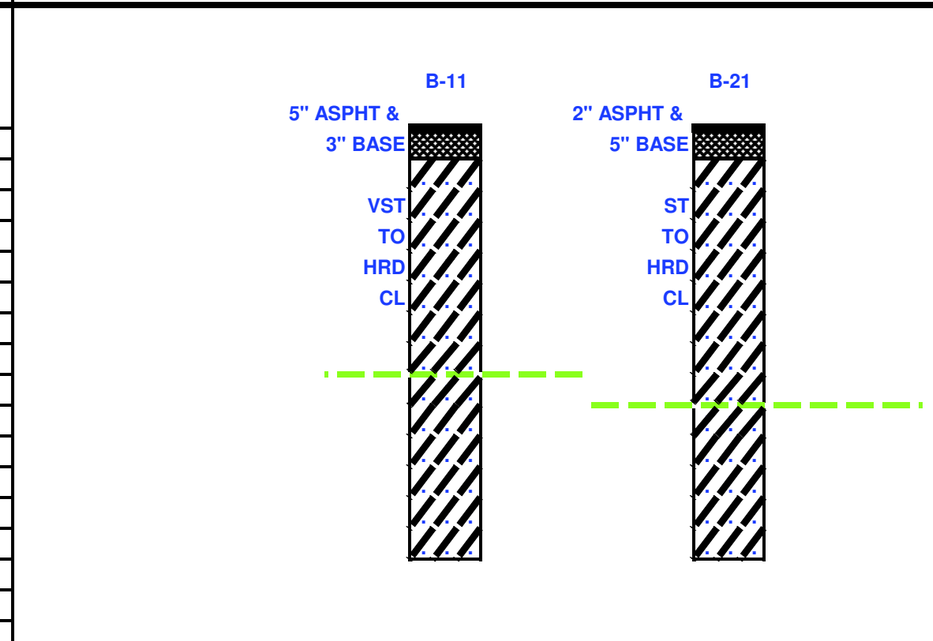
Vertical: 1"= 5'

Figure-4c

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

WBS No. S-000035-0182-3



PROFILE ALONG TABOR STREET

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4d

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

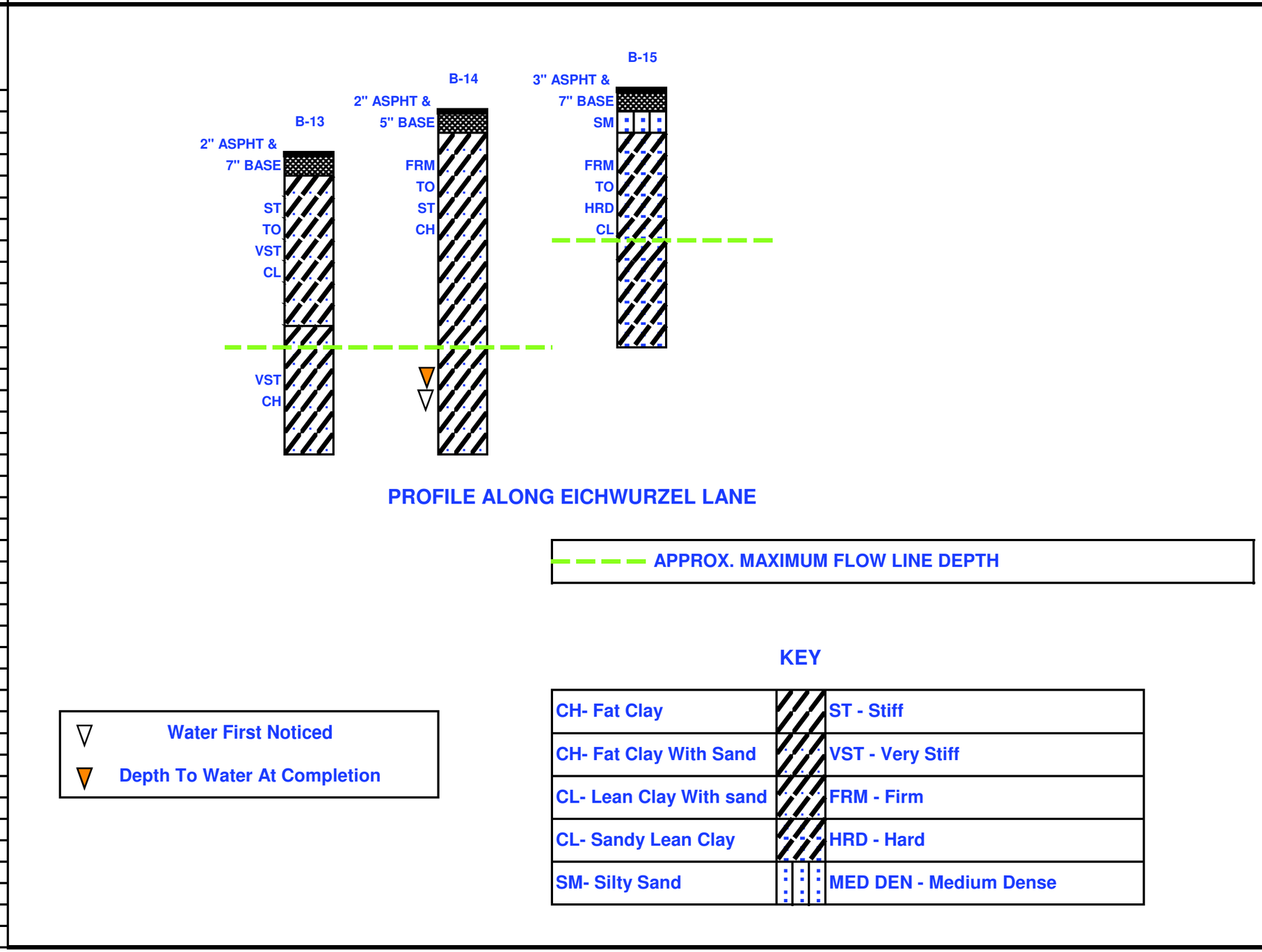
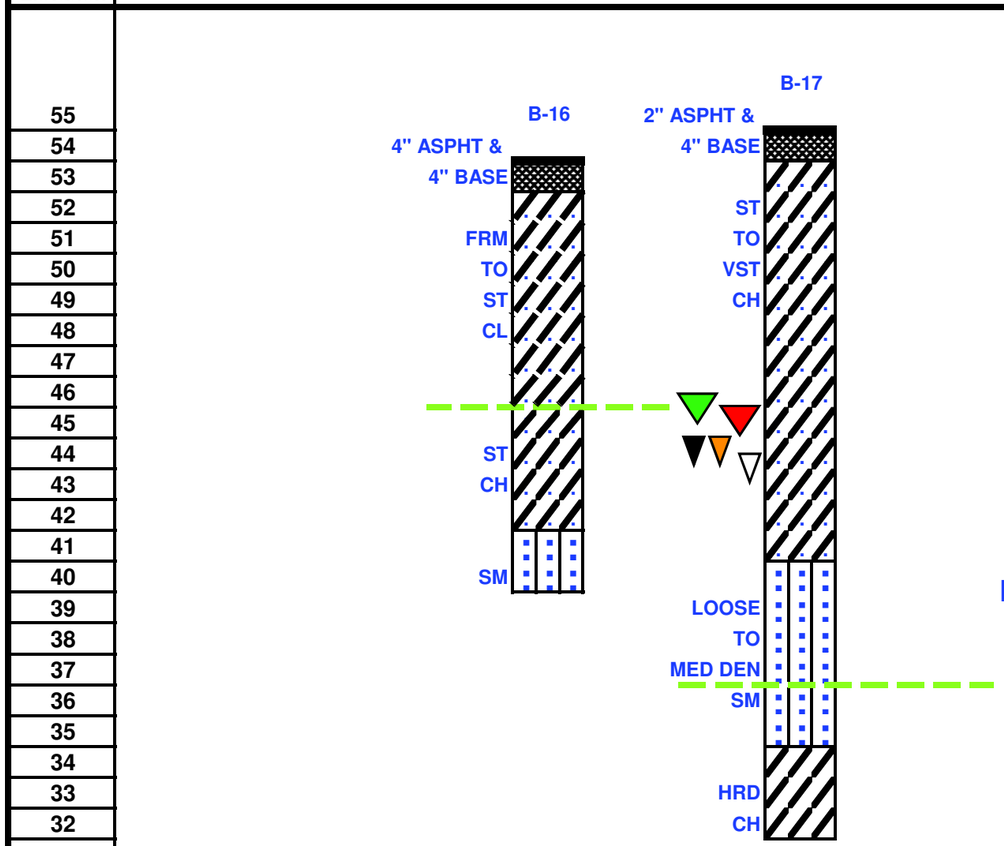


Figure-4e

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

WBS No. S-000035-0182-3



PROFILE ALONG ROBERT LEE ROAD

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

24 hr. Water Level

PZ Water Level (3-14-13)

PZ Water Level (4-10-13)

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

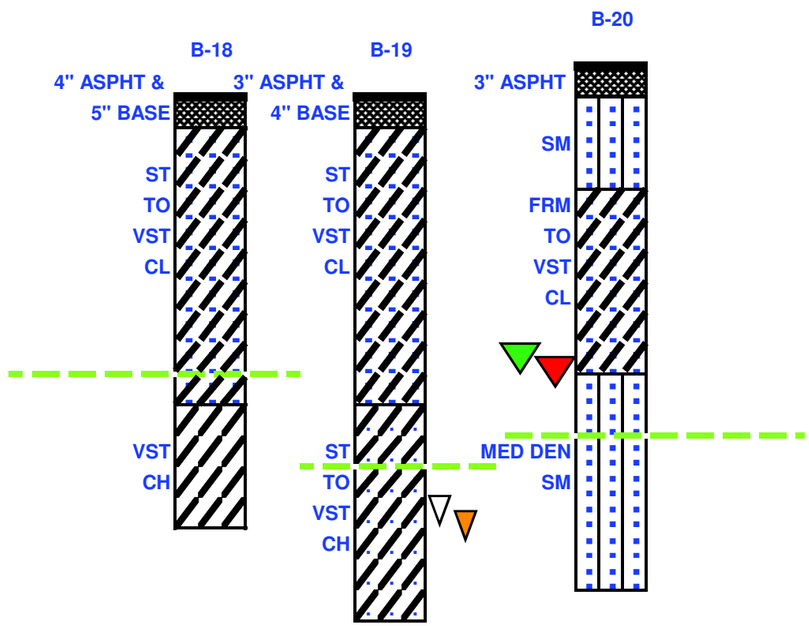
Vertical: 1"= 5'

Figure-4f

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

Elevation **WBS No. S-000035-0182-3**



PROFILE ALONG LEON/DELANY STREET

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

24 hr. Water Level

PZ Water Level (3-14-13)

PZ Water Level (4-10-13)

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4g

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

WBS No. S-000035-0182-3

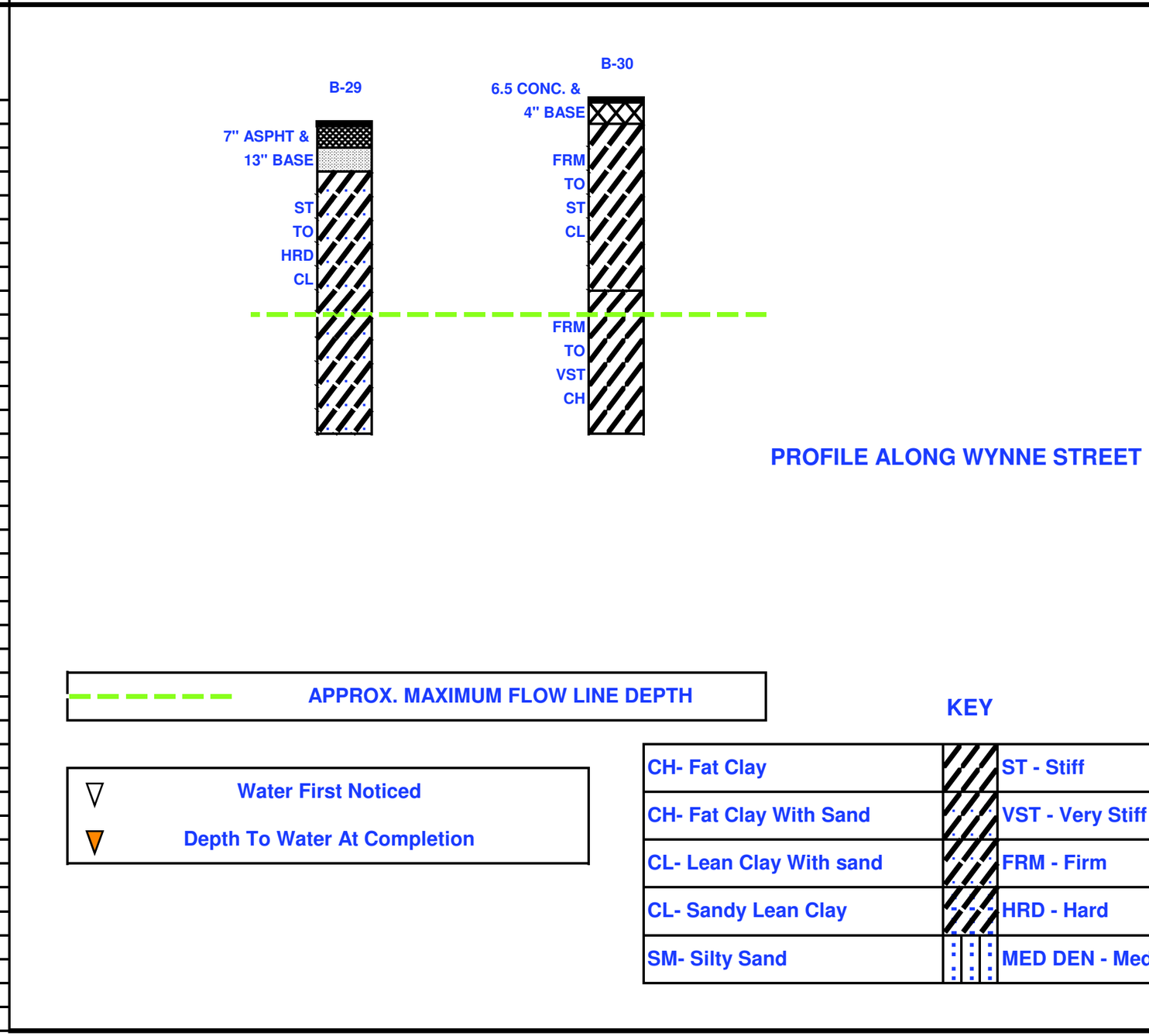
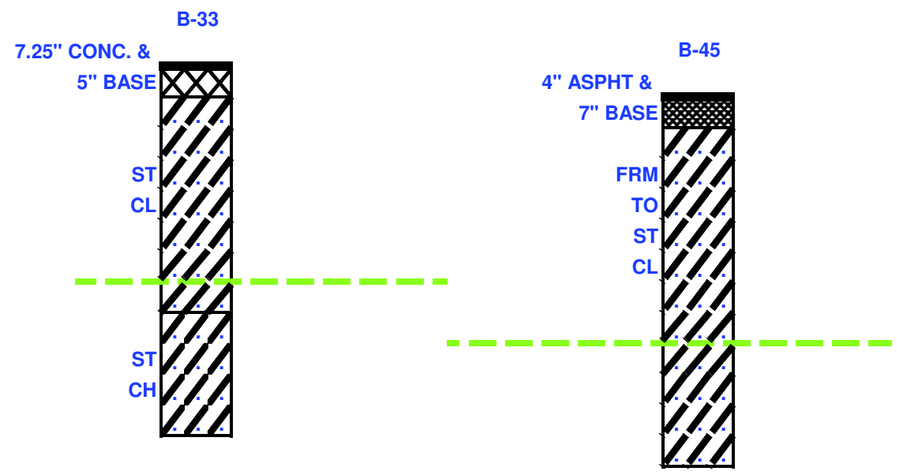


Figure-4h

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G10-120**

WBS No. S-000035-0182-3



PROFILE ALONG EAST 22ND STREET

APPROX. MAXIMUM FLOW LINE DEPTH

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

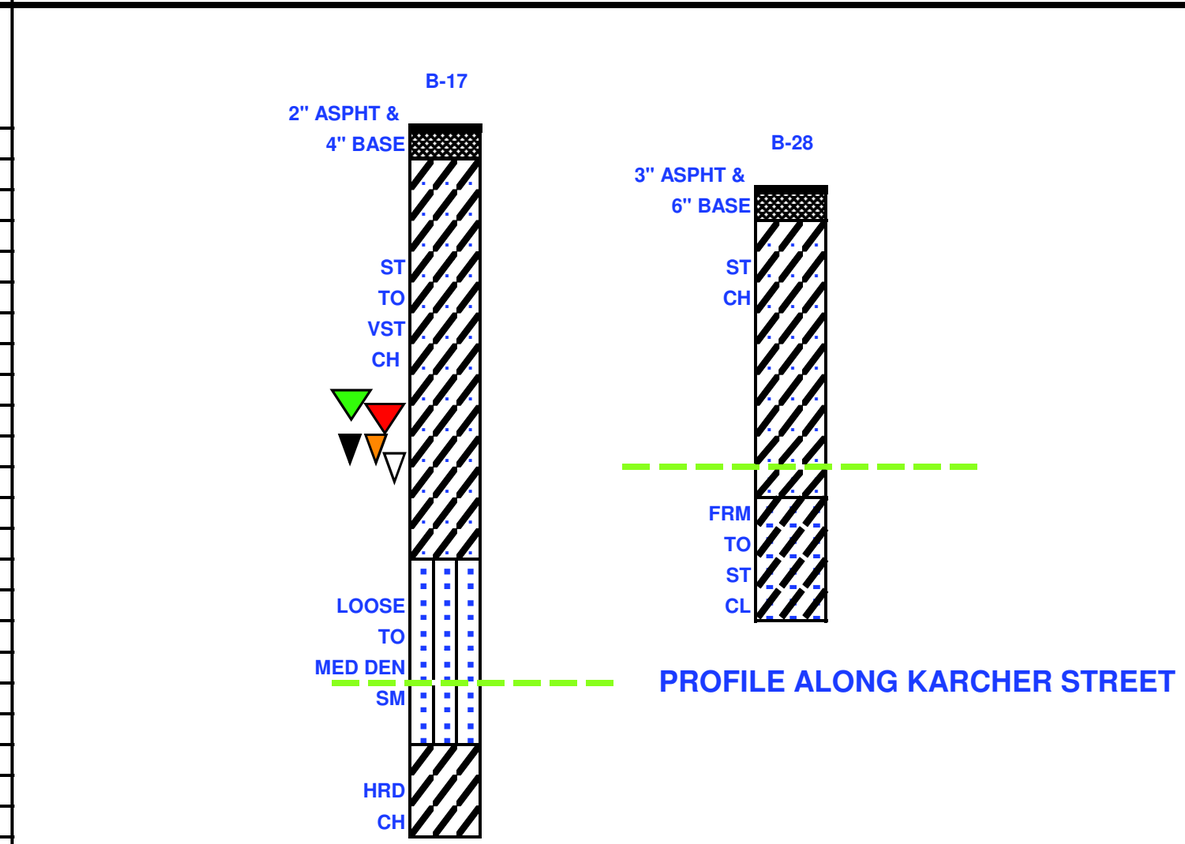
Vertical: 1"= 5'

Figure-4i

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



▽	Water First Noticed
▼	Depth To Water At Completion
▼	24 hr. Water Level
▼	PZ Water Level (3-14-13)
▼	PZ Water Level (4-10-13)

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

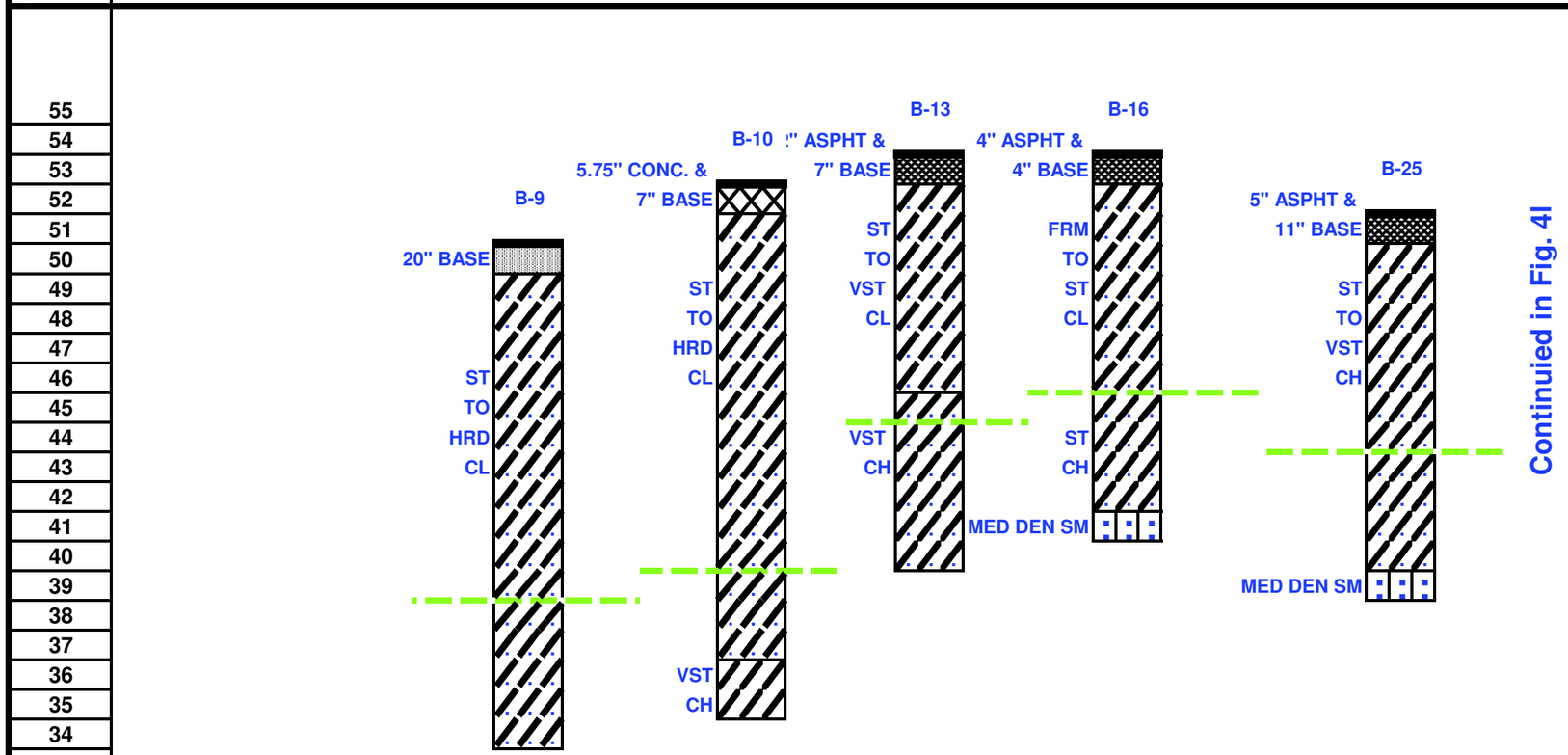
SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4j

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG I-45 FRONTAGE ROAD (SOUTH BOUND) - 1 OF 2

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sa	VST - Very Stiff
CL- Lean Clay With s	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4k

ASSOCIATED TESTING LABORATORIES, INC.

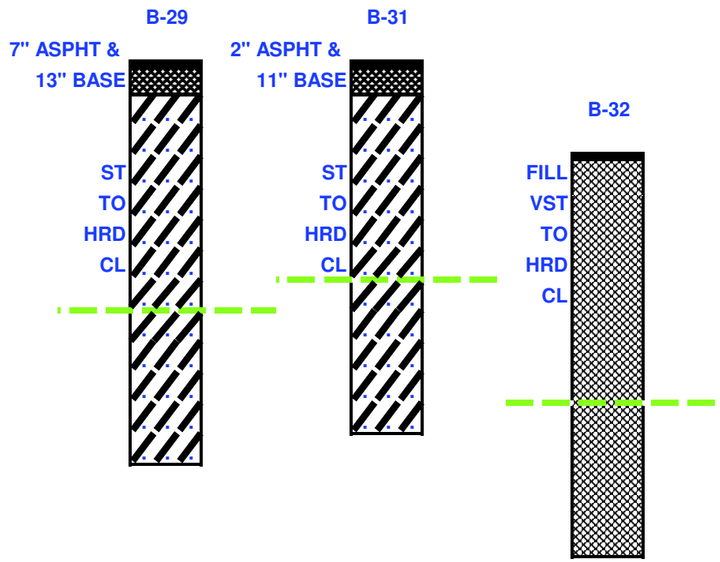
PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

Elevation

53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37

Continuied From Fig. 4k



PROFILE ALONG I-45 FRONTAGE ROAD (SOUTH BOUND) - 2 OF 2

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4l

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

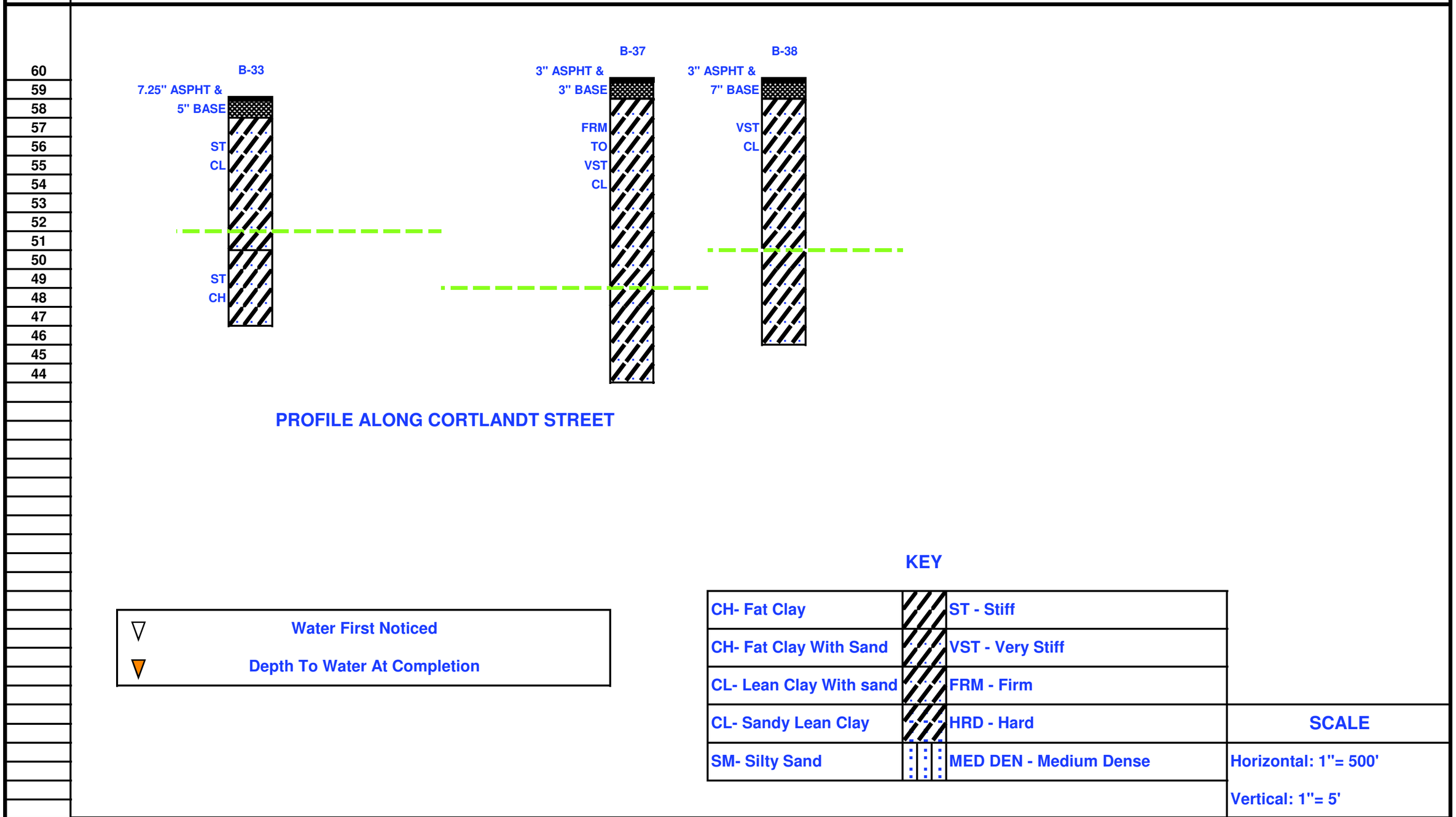


Figure-4m

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

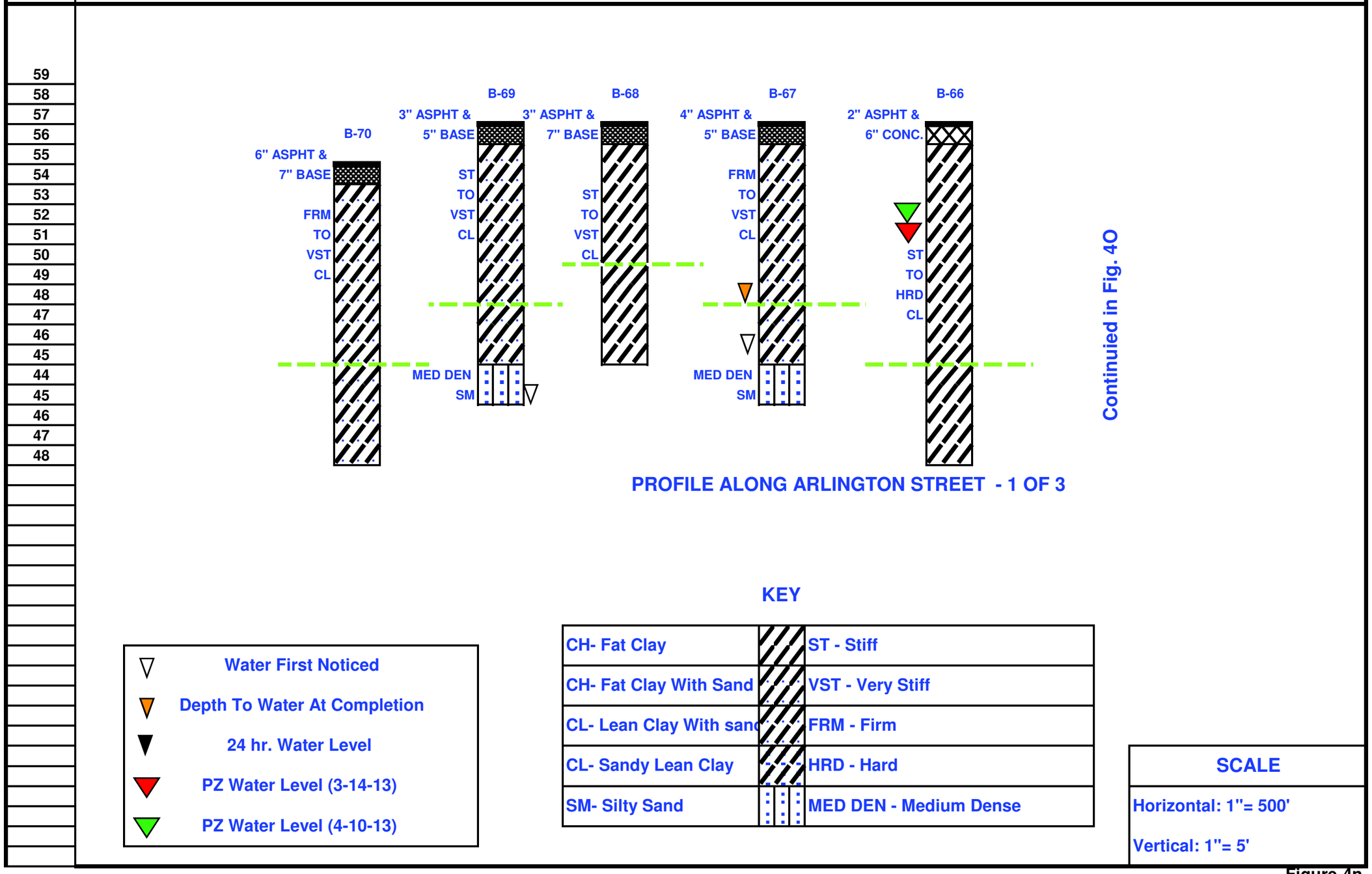


Figure-4n

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

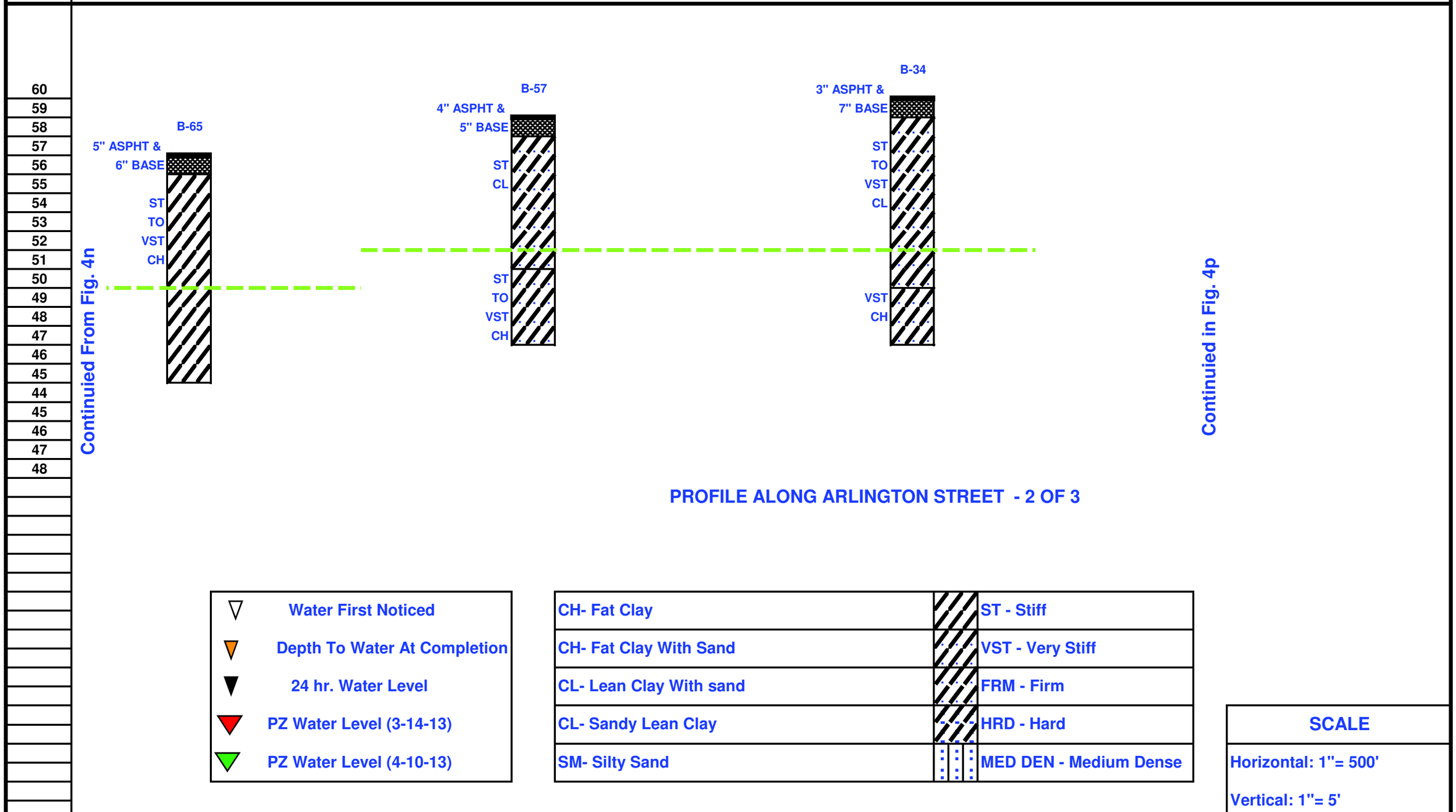


Figure-4o

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

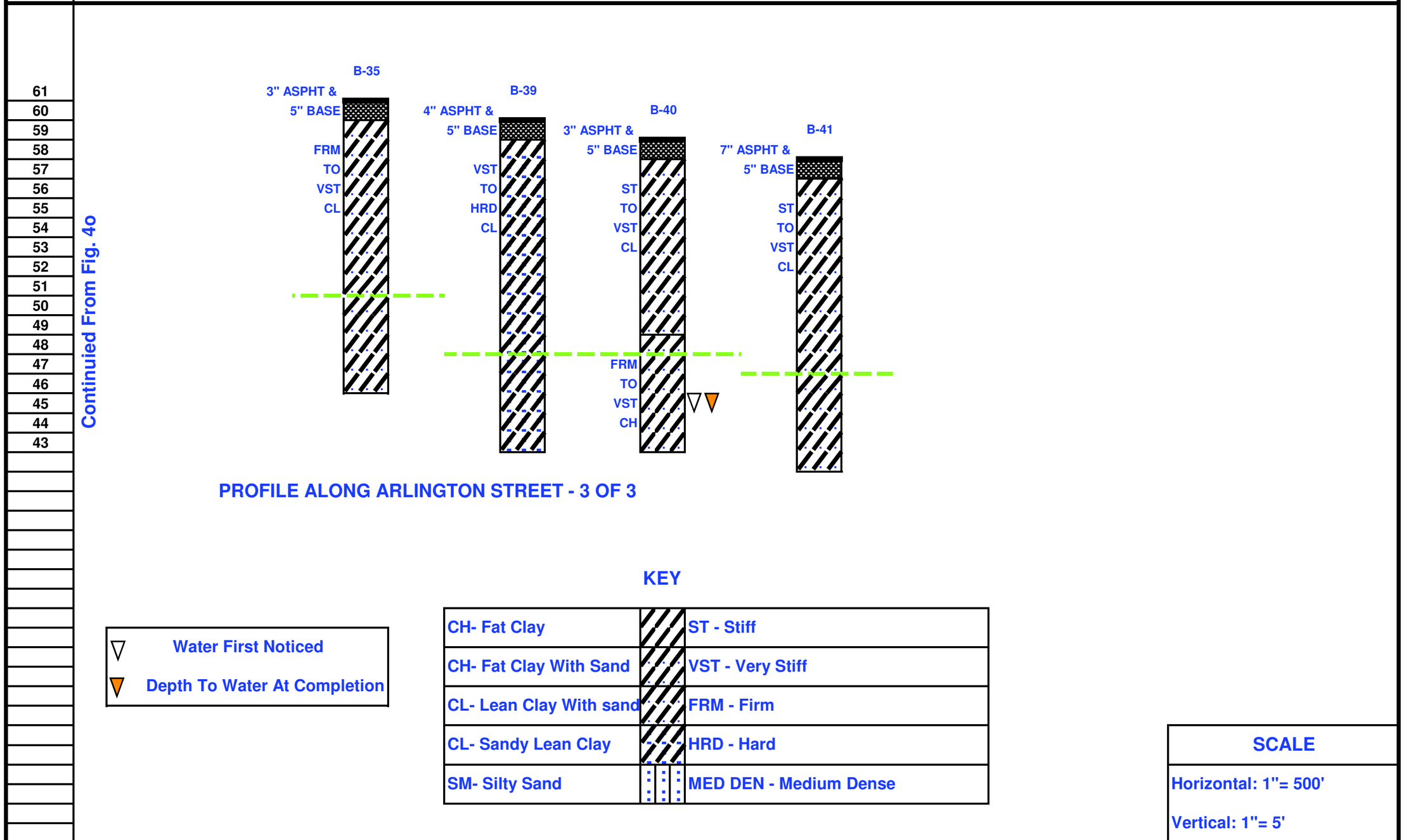
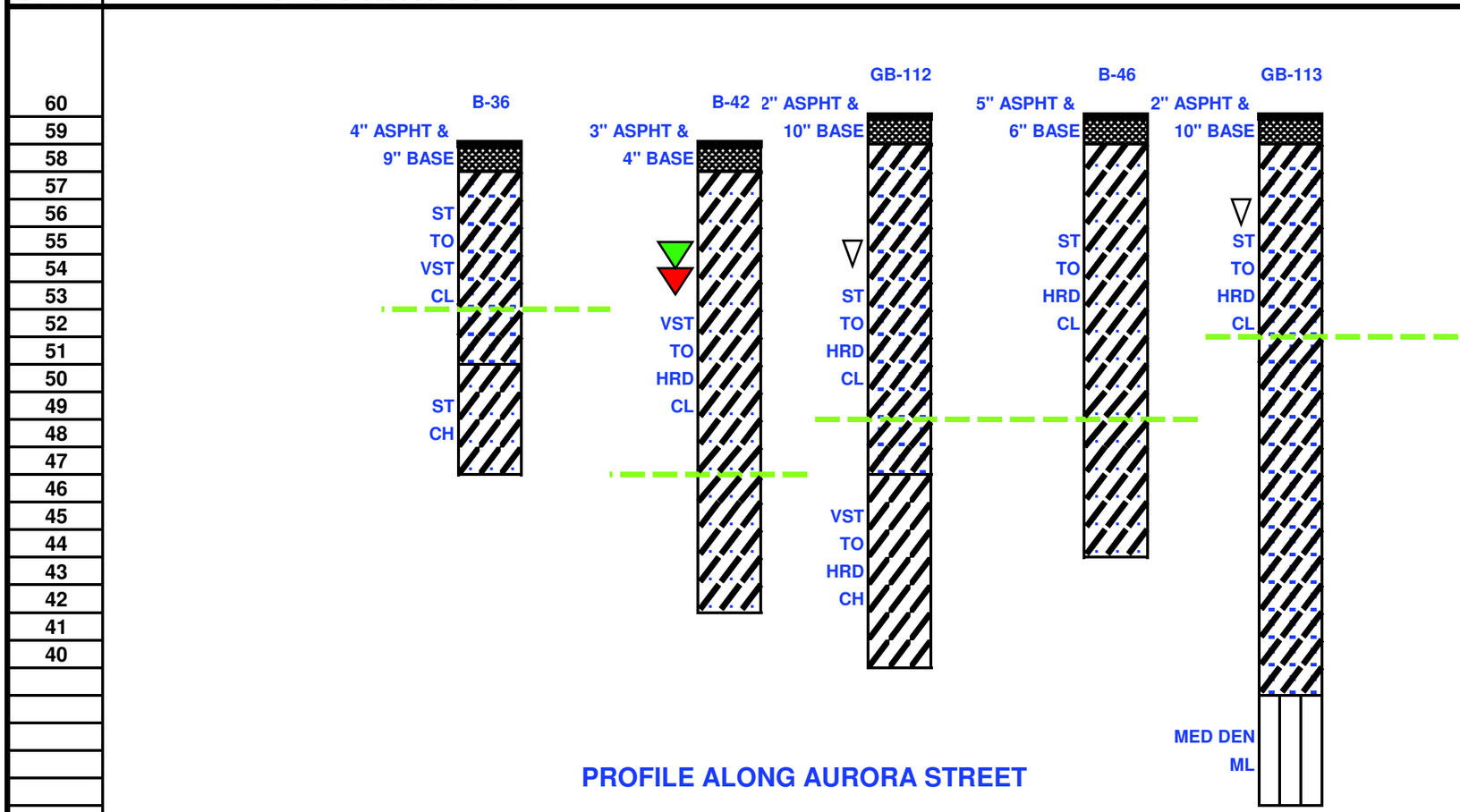


Figure-4p

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA — **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG AURORA STREET

NOTE: BORINGS GB-112 AND GB-113 WERE DRILLED BY OTHER IN 1994. THEY ARE AT APPROXIMATE DISTANCE.

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

- Water First Noticed
- Depth To Water At Completion
- 24 hr. Water Level
- PZ Water Level (3-14-13)
- PZ Water Level (4-10-13)

SCALE

Horizontal: 1"= 500'

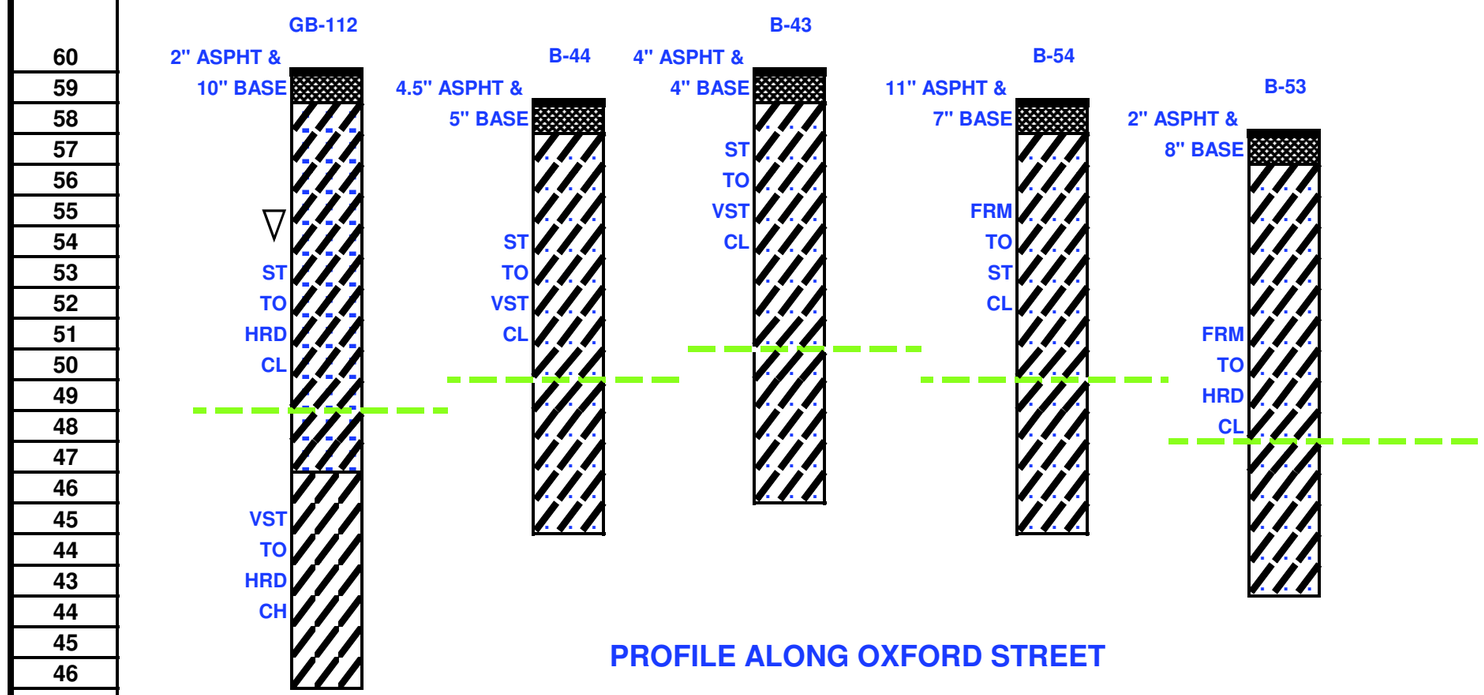
Vertical: 1"= 5'

Figure-4q

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

Elevation **WBS No. S-000035-0182-3**



PROFILE ALONG OXFORD STREET

▽	Water First Noticed
▼	Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

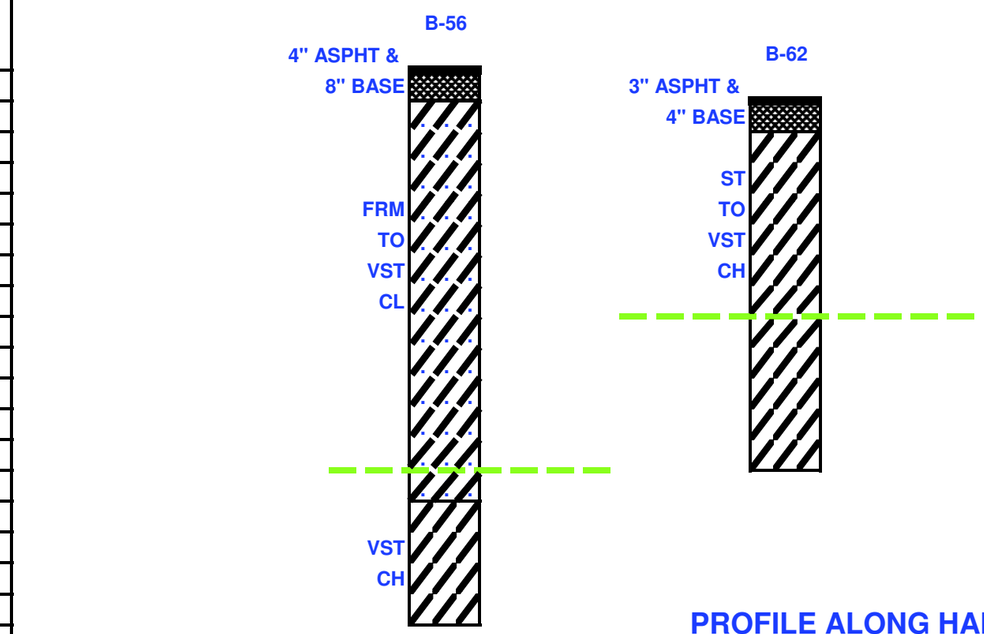
Vertical: 1"= 5'

Figure-4r

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG HARVARD STREET

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

▽ Water First Noticed

▼ Depth To Water At Completion

SCALE

Horizontal: 1"= 500'

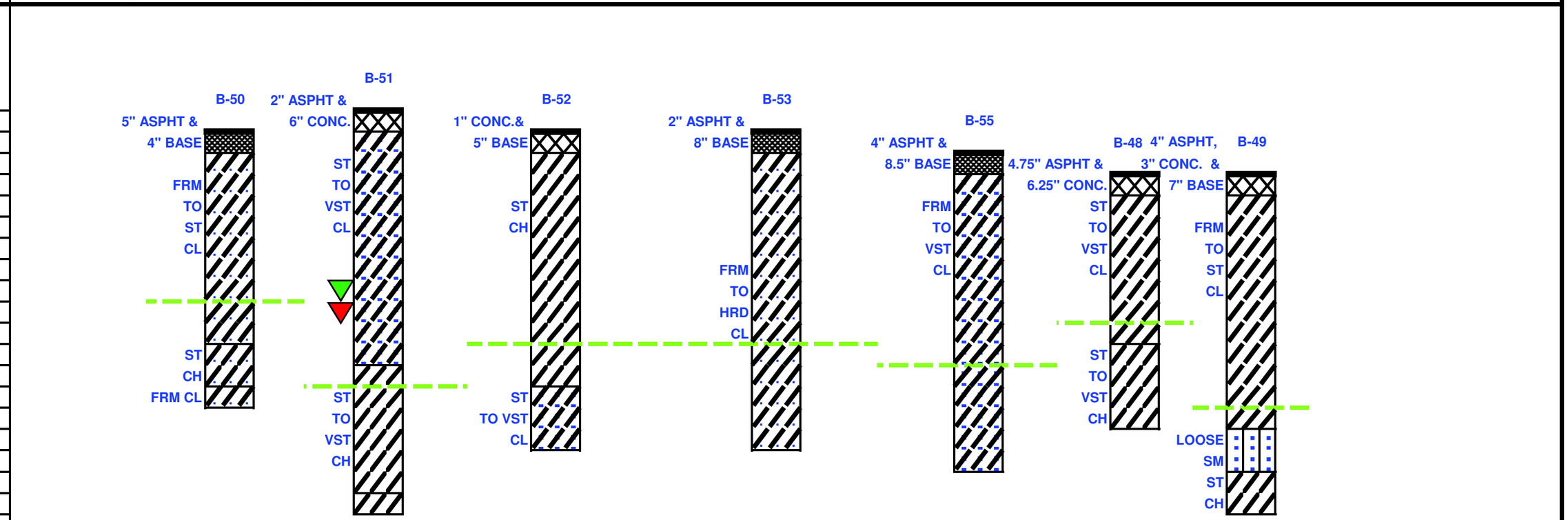
Vertical: 1"= 5'

Figure-4s

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG EAST 20TH

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

- Water First Noticed
- Depth To Water At Completion
- 24 hr. Water Level
- PZ Water Level (3-14-13)
- PZ Water Level (4-10-13)

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4t

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

Elevation **WBS No. S-000035-0182-3**

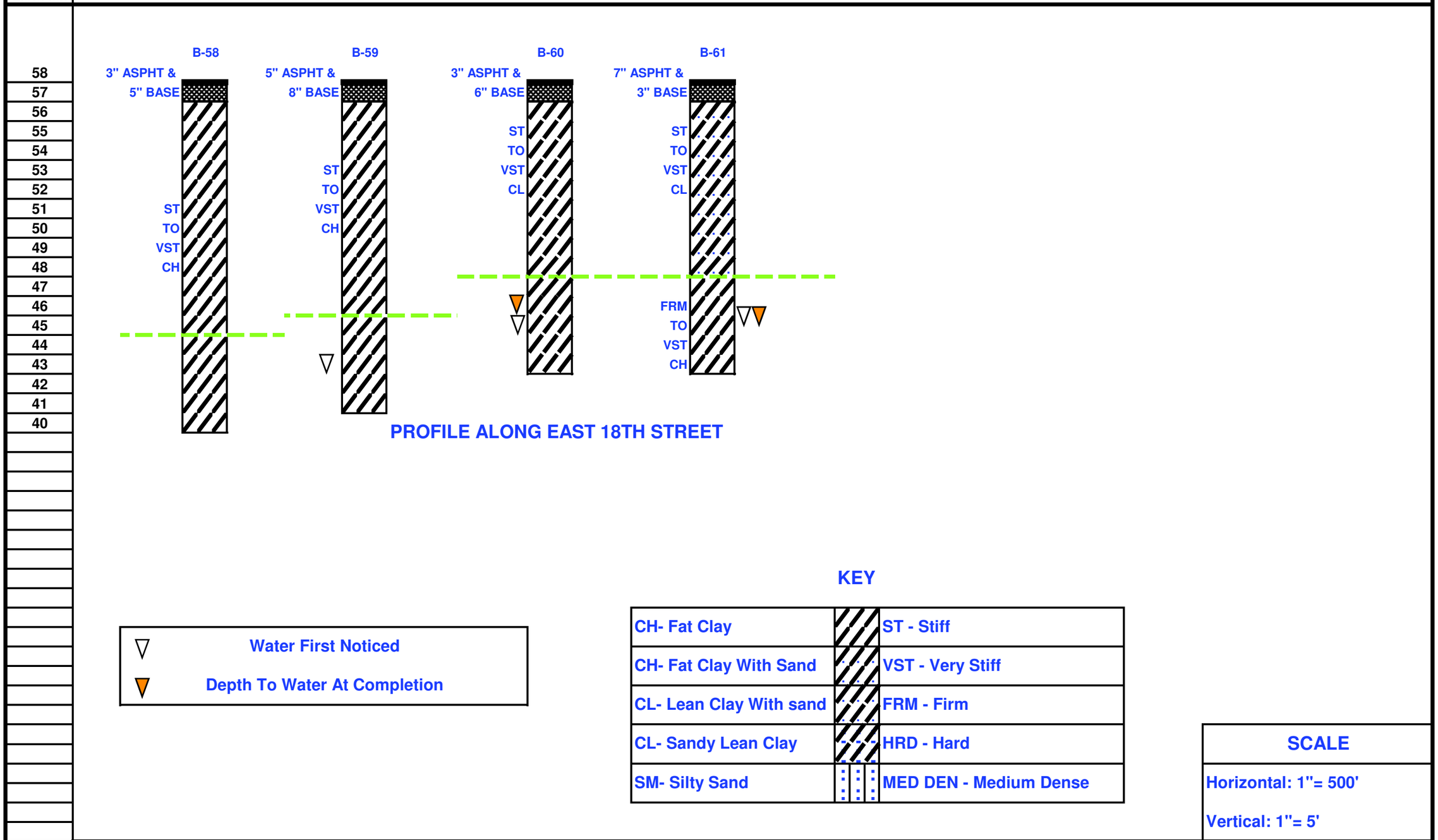
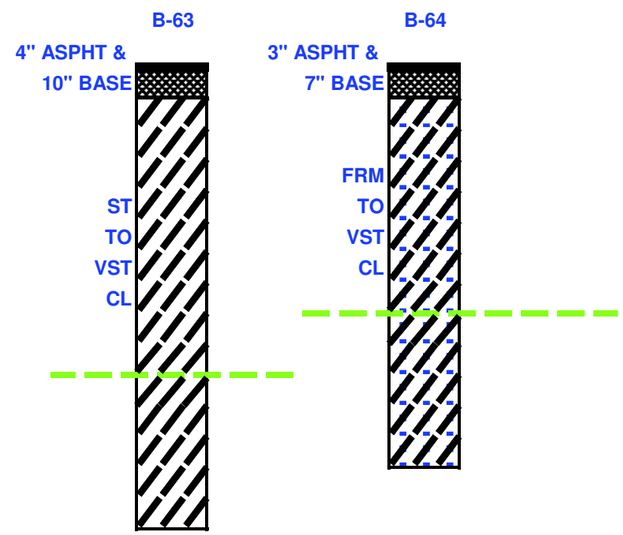


Figure-4u

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG EAST 16TH STREET

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay	ST - Stiff
CH- Fat Clay With Sand	VST - Very Stiff
CL- Lean Clay With sand	FRM - Firm
CL- Sandy Lean Clay	HRD - Hard
SM- Silty Sand	MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

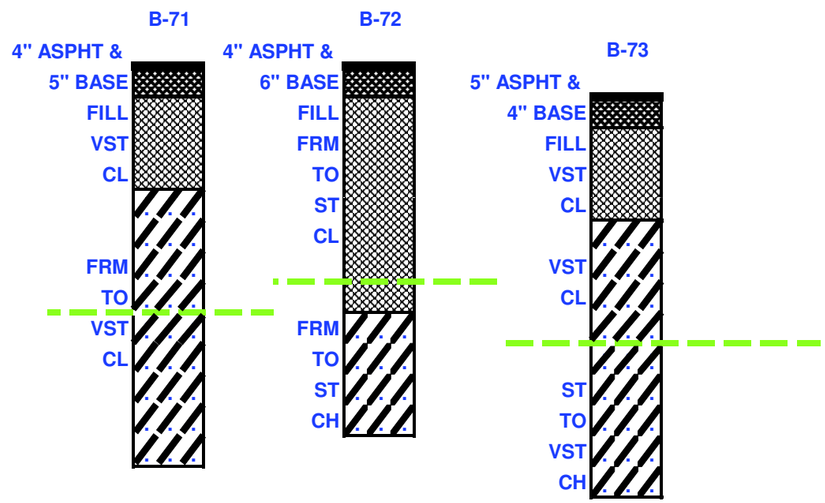
Vertical: 1"= 5'

Figure-4v

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN TALL TIMBERS AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3



PROFILE ALONG 12 1/2 STREET

Water First Noticed

Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE

Horizontal: 1"= 500'

Vertical: 1"= 5'

Figure-4w

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

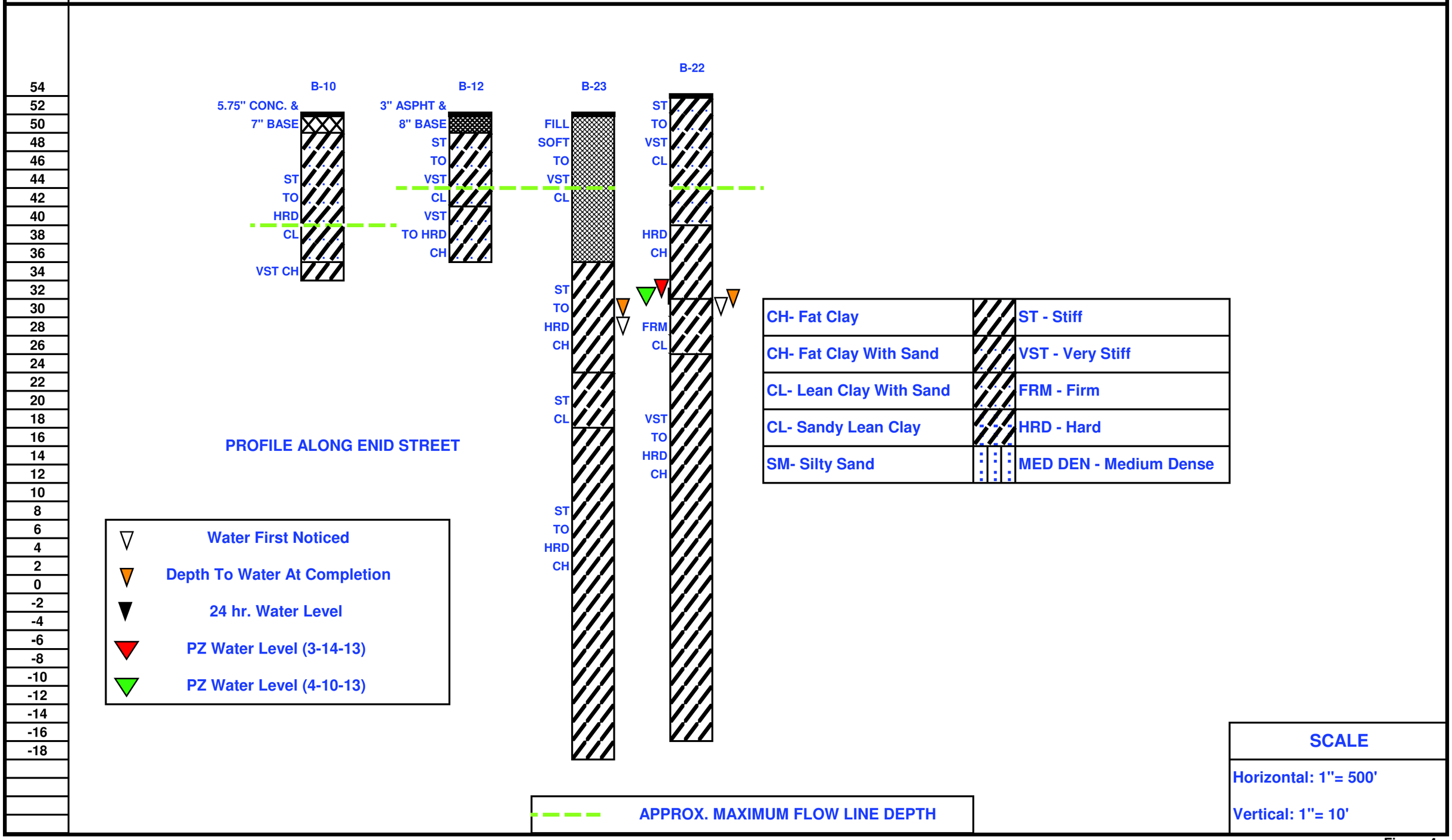


Figure 4x

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA **PROJECT NO. G13-120**

WBS No. S-000035-0182-3

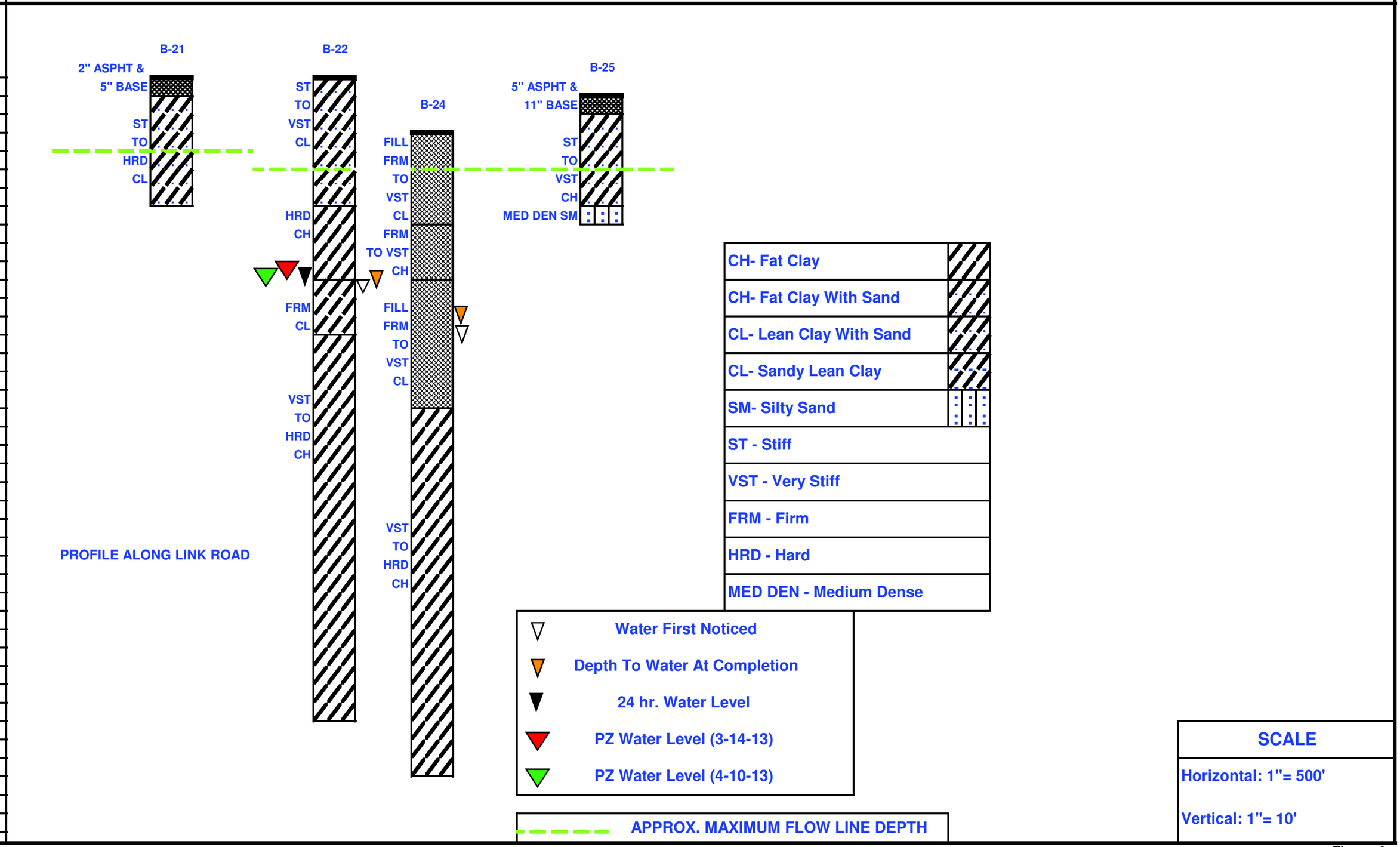
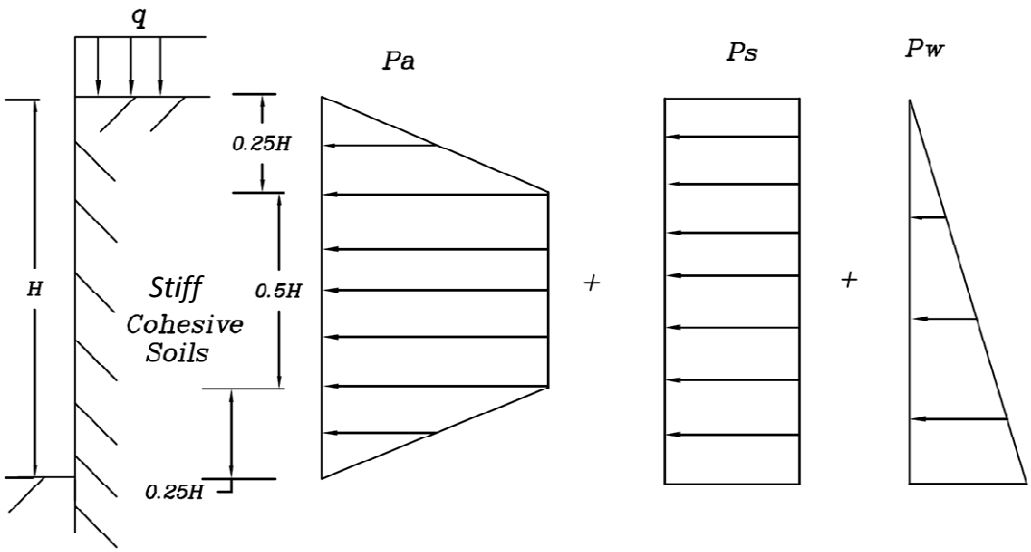
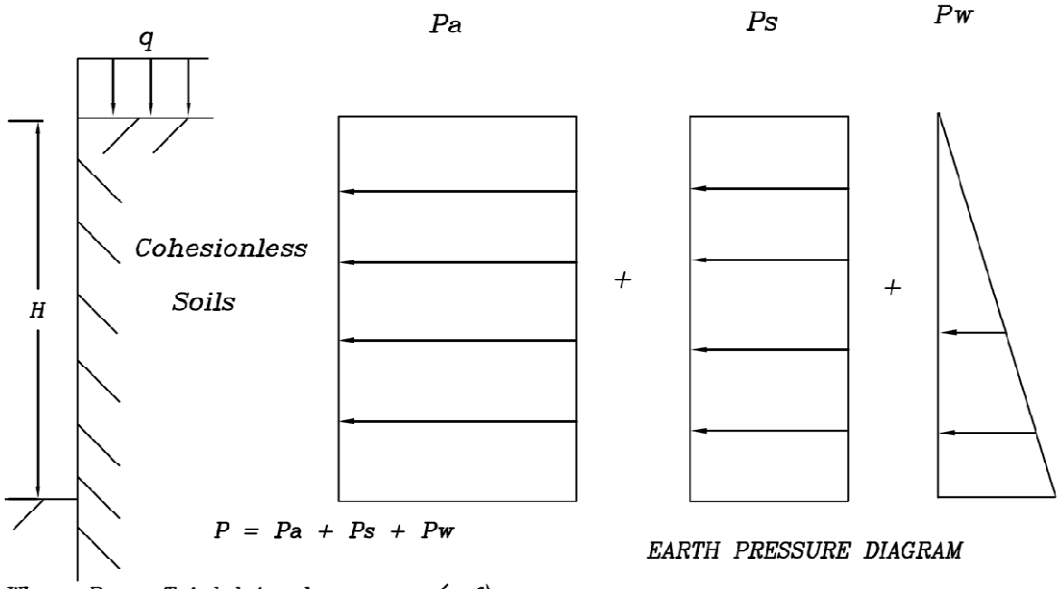


Figure 4y





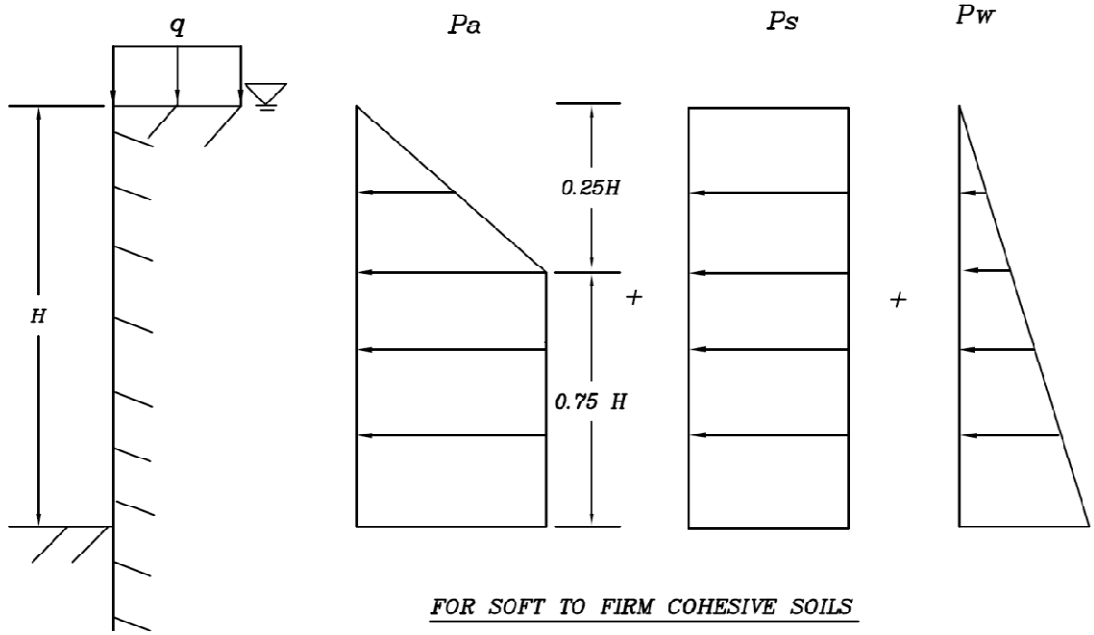
EARTH PRESSURE DIAGRAM

Where P = Total lateral pressure (psf)
Pa = Active earth pressure(psf) = $K_A \gamma H = 0.4 \gamma H$ for Stiff Clays
= $0.65\ K_A \gamma H = 0.25 \gamma H$ for cohesionless Sands ($0.33\ \gamma H$–for loose sand)
Ps = Lateral pressure due to surcharge load (psf) = 0.5q for Clays
= 0.4q for Sands (0.5q for loose Sands)
Pw = Hydrostatic pressure (psf) = 62.4* water depth
H = Depth of braced excavation (ft)
q = Surcharge load (psf) usually taken as 500 psf
γ = Submerged density of soils (pcf) = use 60 pcf (use 50 pcf for loose Sands)

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3
	PROJECT NO. : G13-120 / FIGURE 5a

PST 8/28/12



FOR SOFT TO FIRM COHESIVE SOILS

Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = $1.0 K_a \gamma H$ for soft clays

K_a = Active Earth pressure coefficient

$= 1 - m \frac{2 q_u}{\gamma H} = 1 - m \frac{4C}{\gamma H}$ (taking $C = \frac{q_u}{2}$)

Here $m=1$ for $N<4$ and $m=0.4$ for $N>5$

N= Stability number $=\gamma H/C$

Ps = Lateral pressure due to surcharge load (psf) = K_a for clays

Pw = Hydrostatic pressure (psf) = 62.4* water depth

H = Depth of braced excavation (ft)

q = Surcharge load (psf) usually taken as 500 psf

γ = density of soils (pcf) = use 50 pcf below groundwater and 110 pcf above groundwater

q_u = Unconfined compressive strength, psf

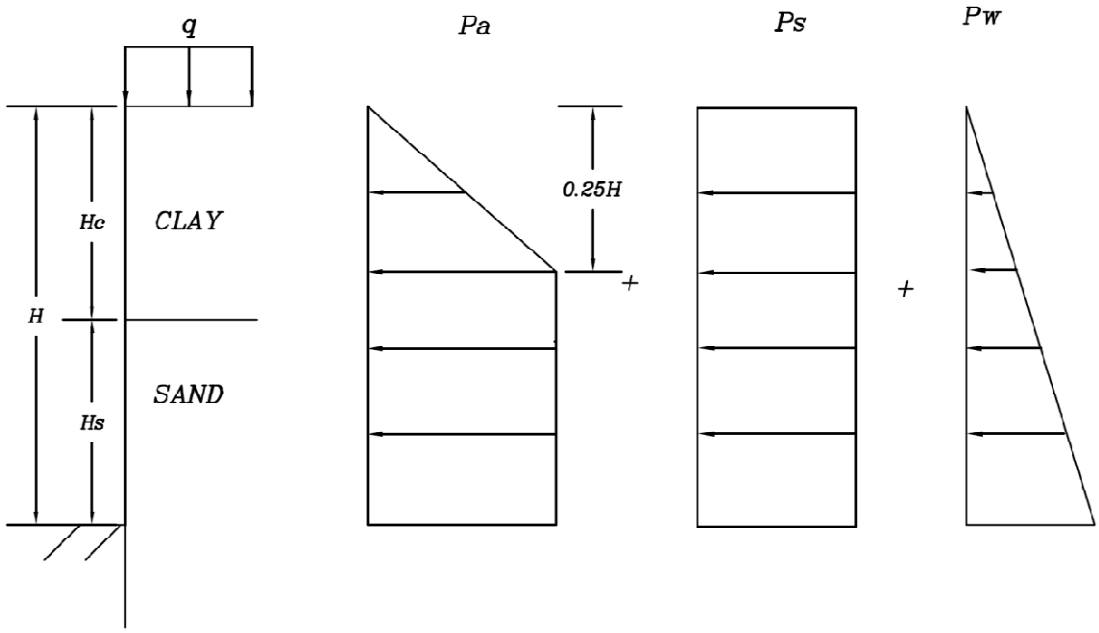
C = Undrained shear strength, psf

Note: Neglect hydrostatic pressure above groundwater level

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3	
	PROJECT NO. : G13-120	FIGURE 5b

PST 8/28/12



$$P = Pa + Ps + Pw$$

Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = $K_A \gamma H = 0.4 \gamma H$

Ps = Lateral pressure due to surcharge load (psf) = $0.5q$

Pw = Hydrostatic pressure (psf) = 62.4* water depth

H = Depth of braced excavation (ft)

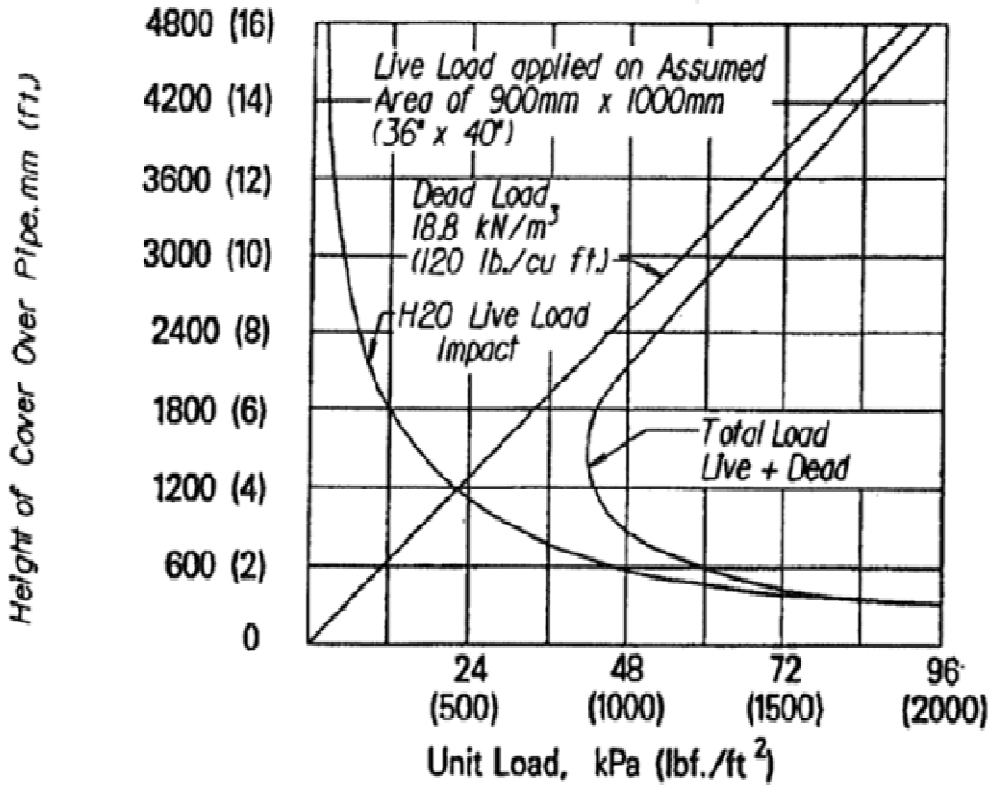
q = Surcharge load (psf) usually taken as 500 psf

γ = Submerged density of soils (pcf) = use 60 pcf

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3
	PROJECT NO. : G13-120 / FIGURE 5c

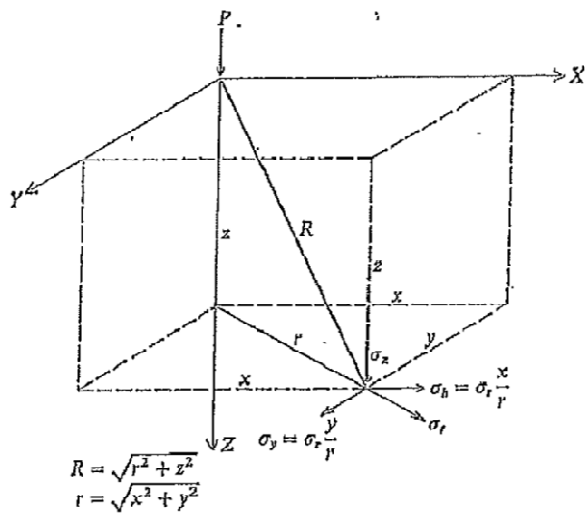
PST 8/28/12



Combined H20 highway live load and dead load is a minimum at about 1500mm (5 ft.) of cover, applied through a pavement 300mm (1 ft.) thick.

HIGHWAY LOADING ON A PIPE UNDER VARIOUS SOIL COVER	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3
	PROJECT NO. : G13-120 / FIGURE 6

PST 8/28/12



Later Pressure, σ_r:

$\sigma_r = (P/2\pi)\ \{3r^2Z/R^5) - ([1-2\mu]/R[R+z]\}$

For $\mu = 0.5$,

$\sigma_r = P/2\pi\ (2r^2z/R^5)$

Vertical Pressure, σ_z :

$\sigma_z = 3\ P\ z^3 / 2\pi R^5$

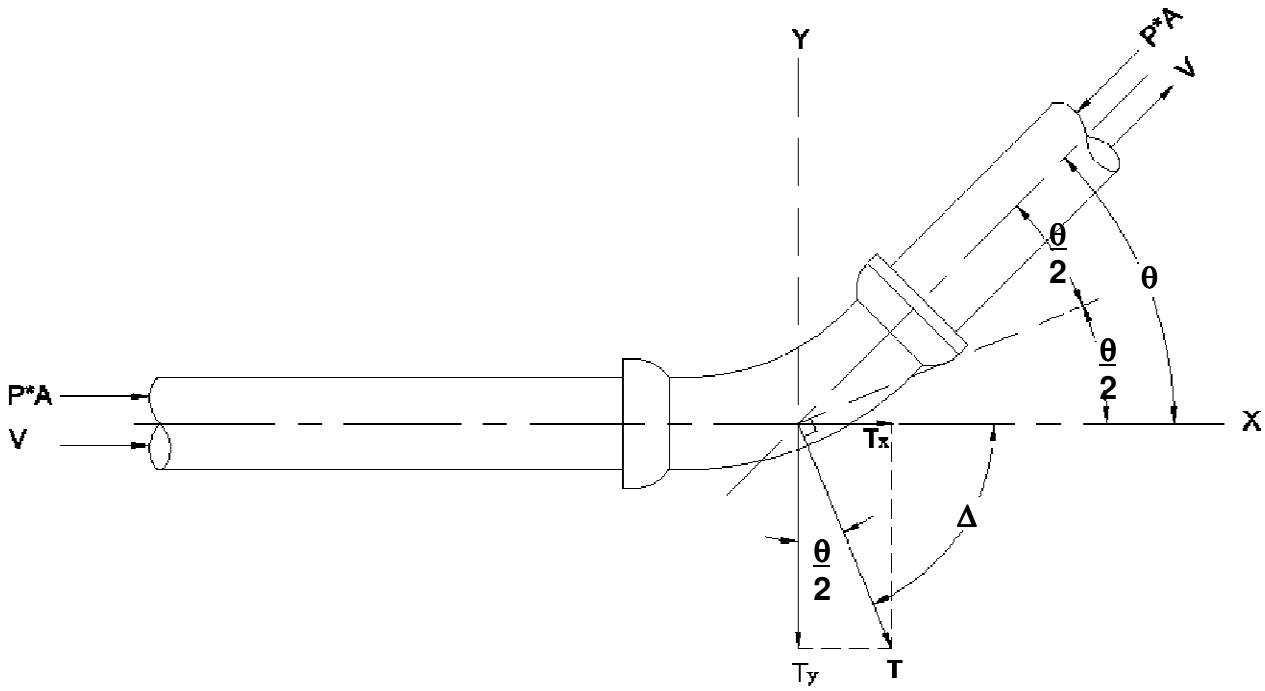
P = Point load surcharge

μ = Poisson's ratio if soils, use 0.5

X, y, z = distance in x, y and z direction, respectively

BOUSSINESQ'S EQUATION FOR POINT LOAD SURCHARGE	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3	
	PROJECT NO. : G13-120	FIGURE 7

PST 8/28/12



$$T = 2\,P\,A \sin\frac{\theta}{2}$$

$$T_x = P\,A\,(1 - \cos\theta)$$

$$T_y = P\,A \sin\theta$$

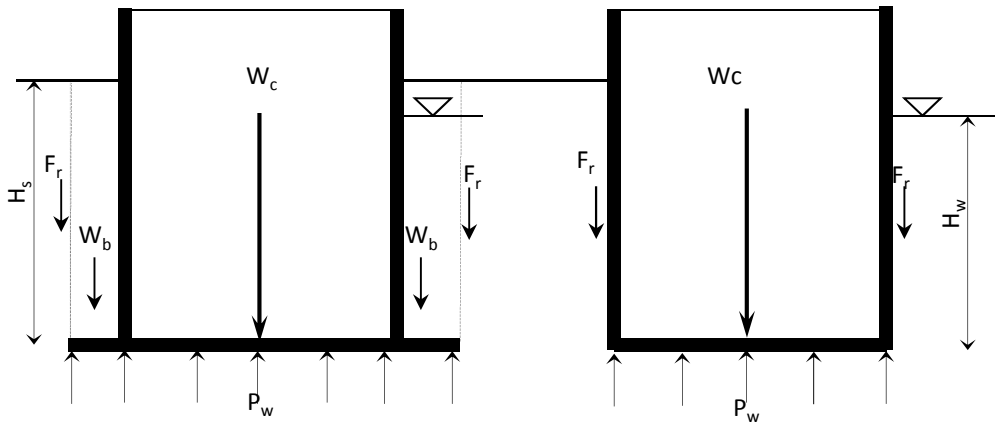
Where:

T	=	Resultant thrust force, lbs
T_x	=	Resultant thrust force component along x-axis, lbs
T_y	=	Resultant thrust force component along y-axis, lbs
P	=	Maximum sustain pressure of fluid in pipe, psi
A	=	Cross-section area of pipe, square inches
D	=	Inside diameter of pipe, inches
θ	=	Angle of the pipe bend, degrees
Δ	=	Angle between x-axis and resultant force
	=	$\tan^{-1}(T_y/T_x)$, degrees
V	=	Fluid velocity

Source: American Water Works Association, "Concrete Pressure Pipes", AWWA Manual M9.

THRUST FORCE AT A PIPE BEND	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3	
	PROJECT NO. : G13-120	FIGURE 8

PST 8/28/12



Dead Weight of Structure + Dead Weight of Backfill Above Base Extension + Frictional Resistance

$P_w = H_w\gamma_w$
$F_u = A_bP_w$
$W_c/S_{fa}+W_b/S_{fb}+ F_r/S_{fc} \geq F_u$
(S_{fa} = 1.1; S_{fb} = 1.5; S_{fc} = 3.0)

Dead Weight of Structure + Frictional Resistance

$P_w = H_w\gamma_w$
$F_u = A_bP_w$
$W_c/S_{fa}+F_r/S_{fc} \geq F_u$
(S_{fa} = 1.1; S_{fc} = 3.0)

For cohesive soils:
$F_r = \alpha c_nA_n$

For cohesionless soils,
$Fr = p_nK\tan\delta_nA_n$

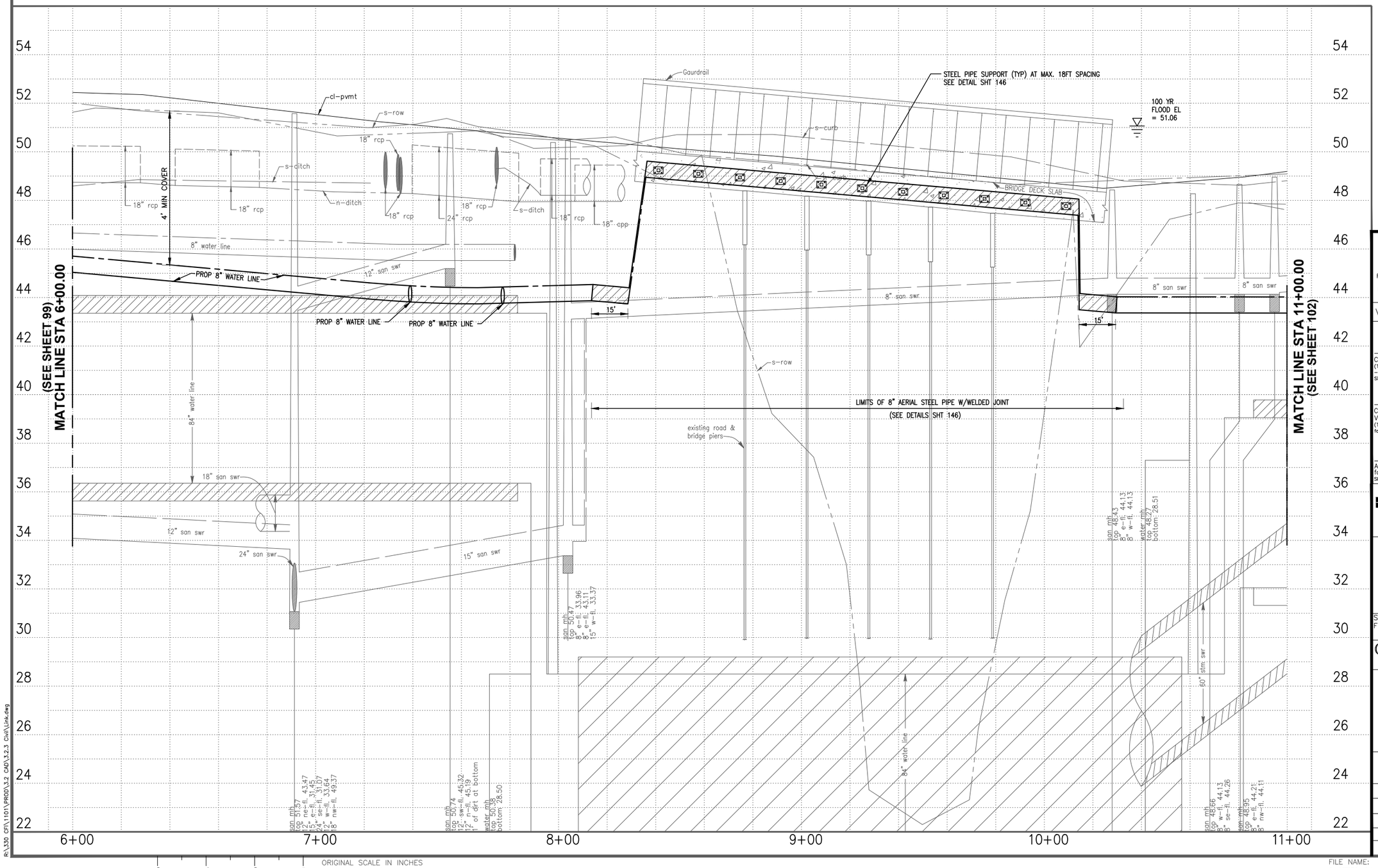
Where,

H_s	=	Buried depth of wall, ft
H_w	=	Height of water table above base of structure, ft
P_w	=	Total uplift pressure = 62.4 x Hw, psf
F_u	=	Total uplift force exerted on base of structure = Pw x A_b
W_c	=	Dead weight of structure, lbs
W_b	=	Weight of backfill above base of structure, lbs
A_b	=	Area of base, ft^2
F_r	=	Friction resistance developed at the soil/wall interface, lbs
A_n	=	Contact area between the soil/wall interface in layer"n"
c_n	=	Undrained shear strength of cohesive soils at layer "n" at soil/wall interface. See individual boring logs. c_n for the top 8 ft of clays with PI higher than 20 percent should be discounted because of the shrink-swell characteristics of high plasticity clays.
α	=	Adhesion factor, to be multiplied with c_n to obtain the adhesion between the soil/wall interface. Use 0.75 if c_n is less than 0.25 tsf, use 0.67 if c_n is between 0.25 and 0.5 tsf, use 0.5 if c_n is greater than 0.5 tsf but limit the adhesion to 1.5 ksf.
K	=	Coefficient of lateral earth pressure of cohesionless soils. Use 0.4.
p_n	=	Average overburden stress at the mid-depth of cohesionless soil layer "n", psf
δ_n	=	Average frictional angle between cohesionless soil layer "n" and the walls of the structure, use 0.75 of the angle of internal friction (ϕ) of the cohesionless soil. A ϕ of 28 degrees may be used if no specific value is given.
$S_{fa,b,c}$	=	Factors of safety against buoyant uplift force.

BUOYANT UPLIFT RESISTANCE OF A BURIED STRUCTURE	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3
	PROJECT NO. : G13-120 / FIGURE 9

PST 8/28/12

LINK ROAD



TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT ENERGY AT 713-207-2222.

NOTICE:

FOR YOUR SAFETY, YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG SO THAT UNDERGROUND LINE CAN BE MARKED. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811.

VERIFICATION OF PRIVATE UTILITY LINES

Date:

CenterPoint Energy/Natural Gas Facilities Verification ONLY.
(This signature verifies that you have shown CNP Natural Gas lines correctly – not to be used for conflict verification) (Gas service lines are not shown)
Signature valid for six months.

Date:

CenterPoint Energy/UNDERGROUND Electrical Facilities Verification ONLY
(This signature verifies existing underground facilities – not to be used for conflict verification.) Signature valid for six months.

Date:

Approved for AT&T Texas/SWBT underground conduit facilities only.
SIGNATURE VALID FOR ONE YEAR

CobbFendley
Texas Registration No. 274
13430 Northwest Freeway, Suite 1100
Houston, Texas 77040
713.462.3242 | fax 713.462.3262
www.cobbfendley.com

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Engineers ● Planners ● Construction Managers
2825 Wilcrest Dr., Suite 600
Houston, Texas 77042
Phone: (713)783-8700, Fax: (713)783-8747
TBPE Firm Registration No. F-4991

THESE PLANS ARE PRELIMINARY AND ARE BEING ISSUED FOR REVIEW BY PUBLIC AGENCIES AND OTHER PRELIMINARY PURPOSES. WHEN ISSUED IN FINAL FORM

BY THE RESPONSIBLE ENGINEER.

RESPONSIBLE ENGINEER:
KIT Professionals, Inc.
SRINIVAS CHINTALAPATI, P.E.
TEXAS REGISTRATION NO.: 109787

SURVEYED BY: KUO, INC
FB NO. P-XXXX

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA

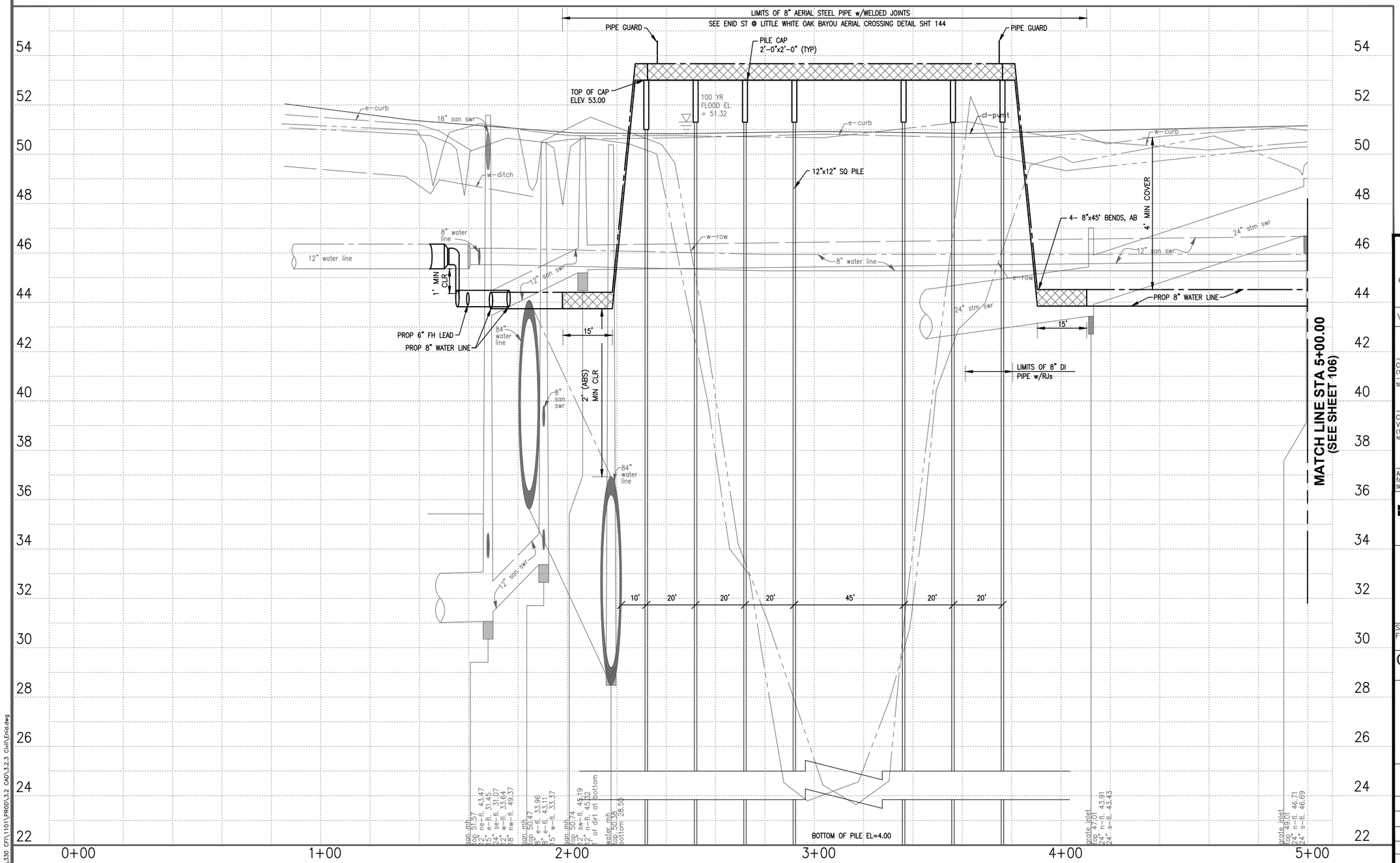
LINK ROAD
STA 6+00 TO 11+00

WBS NO. S-000035-0182-3	
DRAWING SCALE	
VERT. 1"=2' HORIZ. 1"=20'	
CITY OF HOUSTON, PM	
MUKHTAR CHAUDHRY	
SHEET NO.101OF 146	FIGURE 10a

R:\330 CFI\101\PROD\3.2 CAD\3.2.3 Civil\Link.dwg

0 1 2 3 ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

FILE NAME:
PLOTTED ON:



TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT ENERGY AT 713-207-2222.

NOTICE:

FOR YOUR SAFETY, YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG SO THAT UNDERGROUND LINE CAN BE MARKED. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811.

VERIFICATION OF PRIVATE UTILITY LINES

Date:

CenterPoint Energy/Natural Gas Facilities Verification ONLY.
(This signature verifies that you have shown CNP Natural Gas lines correctly – not to be used for conflict verification) (Gas service lines are not shown) Signature valid for six months.

Date:

CenterPoint Energy/UNDERGROUND Electrical Facilities Verification ONLY
(This signature verifies existing underground facilities – not to be used for conflict verification.) Signature valid for six months.

Date:

Approved for AT&T Texas/SWBT underground conduit facilities only.
SIGNATURE VALID FOR ONE YEAR

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Texas Registration No. 274
13430 Northwest Freeway, Suite 1100
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Engineers ● Planners ● Construction Managers
2825 Wilcrest Dr., Suite 600
Houston, Texas 77042
Phone: (713)783-8700, Fax: (713)783-8747
TBPE Firm Registration No.: F-4961

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BY THE RESPONSIBLE ENGINEER.

RESPONSIBLE ENGINEER:
KIT Professionals, Inc.
SRINIVAS CHINTALAPATI, P.E.
TEXAS REGISTRATION NO.: 109787

SURVEYED BY: KUO, INC
FB NO. P-XXXX

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA

ENID STREET
STA 1+00 TO 5+00

WBS NO. S-000035-0182-3	
DRAWING SCALE	
VERT. 1"=2' HORIZ. 1"=20'	
CITY OF HOUSTON, PM	
MUKHTAR CHAUDHRY	
SHEET NO.105 OF 146	FIGURE 10b

R:\330 CP\1101\PROD\3.2 CAD\3.2.3 Civil\Enid.dwg

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
0 1 2 3

FILE NAME:
PLOTTED ON:

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TABLE 2	SUMMARY OF GROUNDWATER MEASUREMENTS
TABLE 3	SUMMARY OF TEST RESULTS
TABLE 4	MARSTON SOIL COEFFICIENT (Cd) FOR TRENCH CONDUITS

TABLE 1
SUMMARY OF PAVEMENT MEASUREMENTS
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS
WBS NO. S-000035-0182-3
ATL JOB NO. G13-120

Boring Number	Boring Depth (ft)	Piezometer		Asphalt Paving (inch)	Concrete Paving (inch)	Base Material (inch)
		No.	Depth (ft)			
B-1	14	--	--	2	--	4” Crushed stone and gravel
B-2	13	--	--	2.5	--	3.75” Crushed shell
B-3 (PZ-1)	17	PZ-1	17	2	--	--
B-4	15	--	--	4	--	10” Crushed Shell
B-5	14	--	--	2.5	--	7” Crushed shell
B-6	15	--	--	5	--	3” Crushed gravel
B-7	13	--	--	3	--	6” Crushed stone
B-8	14	--	--	3	--	8” Crushed stone
B-9	17	--	--	--	--	20” Lime stabilized shell
B-10	18	--	--	--	5.75	7” Lime stabilized shell
B-11	14	--	--	5	--	3” Crushed stone
B-12	15	--	--	3	--	8” Crushed gravel
B-13	14	--	--	2	--	7” Crushed gravel
B-14	16	--	--	2	--	5” Crushed gravel
B-15	12	--	--	3	--	7” Crushed limestone
B-16	13.5	--	--	4	--	4” Crushed gravel
B-17 (PZ-3)	23	PZ-3	23	2	--	4” Lime stabilized shell
B-18	14	--	--	4	--	5” Crushed gravel
B-19	17	--	--	3	--	4” Crushed gravel with shell
B-20 (PZ-2)	17.5	PZ-2	17	3	--	--
B-21	14	--	--	2	--	5” Shell
B-22 (PZ-4)	70	PZ-4	40	--	--	--
B-23	70	--	--	--	--	--
B-24	70	--	--	--	--	--
B-25	13.5	--	--	5	--	11” Crushed gravel
B-26	15	--	--	1.25	4.5	1” Sand
B-27	14	--	--	3.5	--	12” Crushed stone
B-28	14	--	--	3	--	6” Lime stabilized
B-29	13	--	--	7	--	13” Crushed gravel
B-30	14	--	--	--	6.5	4” Crushed limestone
B-31	12	--	--	2	--	11” Crushed gravel
B-32	13	--	--	--	--	--
B-33	12	--	--	--	7.25	5” Sand
B-34	13	--	--	3	--	7” Shell
B-35	15	--	--	3	--	5” Shell
B-36	12	--	--	4	--	9” Shell
B-37	16	--	--	3	--	3” Lime stabilized
B-38	14	--	--	3	--	7” Crushed gravel
B-39	17	--	--	4	--	5” Shell
B-40	16	--	--	3	--	5” Shell
B-41	16	--	--	7	--	5” Crushed gravel

TABLE 1
SUMMARY OF PAVEMENT MEASUREMENTS
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS
WBS NO. S-000035-0182-3
ATL JOB NO. G13-120

Boring Number	Boring Depth (ft)	Piezometer		Asphalt Paving (inch)	Concrete Paving (inch)	Base Material (inch)
		No.	Depth (ft)			
B-42 (PZ-5)	17	PZ-5	17	3	--	4” Crushed stone
B-43	14	--	--	4	--	4” Crushed gravel
B-44	14	--	--	4.5	--	5” Shell
B-45	12	--	--	4	--	7” Shell
B-46	16	--	--	5	--	6” Shell
B-47	15	--	--	3	--	3.5” Crushed limestone
B-48	12	--	--	4.75	6.25	--
B-49	16	--	--	4	3	7” Stabilized shell
B-50	13	--	--	5	--	4” Crushed limestone and shell
B-51 (PZ-6)	18	PZ-6	18	2	6	--
B-52	15	--	--	--	1	5” Shell
B-53	15	--	--	2	--	8” Crushed limestone with shell
B-54	14	--	--	11	--	7” Crushed gravel
B-55	15	--	--	4	--	8.5” Cement stabilized shell
B-56	18	--	--	4	--	8” Crushed gravel
B-57	12	--	--	4	--	5” Crushed gravel
B-58	18	--	--	3	--	5” Crushed gravel and shell
B-59	17	--	--	5	--	8” Crushed gravel and stone
B-60	15	--	--	3	--	6” Crushed gravel
B-61	15	--	--	7	--	3” Crushed gravel
B-62	12	--	--	3	--	4” Crushed gravel
B-63	15	--	--	4	--	10” Crushed gravel
B-64	13	--	--	3	--	7” Crushed gravel
B-65	12	--	--	5	--	6” Crushed limestone and shell
B-66 (PZ-7)	17	PZ-7	17	2	6	--
B-67	14	--	--	4	--	5” Crushed stone
B-68	12	--	--	3	--	7” Crushed gravel and shell
B-69	14	--	--	3	--	5” Crushed gravel
B-70	15	--	--	6	--	7” Crushed gravel
B-71	13	--	--	4	--	5” Crushed gravel and shell
B-72	12	--	--	4	--	6” Crushed gravel and shell
B-73	13	--	--	5	--	4” Crushed gravel

TABLE 2

SUMMARY OF GROUNDWATER MEASUREMENTS
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS
WBS NO. S-000035-0182-3
ATL PROJECT NO. G13-120

Boring Number	Location	Ground Water During Drilling	Ground Water Upon Completion of Drilling	Ground Water in Piezometer (after 24 hrs)	Ground Water in Piezometer (after 7 days)	Ground Water in Piezometer (after 30 days)
B-1	Eastman St.	Dry	Dry	--	--	--
B-2	E.28th St.	Dry	Dry	--	--	--
B-3 (PZ-1)	Eastman St.	Dry	Dry	(3/06/2013) Dry	(3/14/2013) 13’	(4/10/ 2013) 8’
B-4	Angeline St.	Dry	Dry	--	--	--
B-5	Samual St.	Dry	Dry	--	--	--
B-6	Service St.	Dry	Dry	--	--	--
B-7	Eastman St.	Dry	Dry	--	--	--
B-8	Service St.	Dry	Dry	--	--	--
B-9	Walton St.	Dry	Dry	--	--	--
B-10	Enid St.	Dry	Dry	--	--	--
B-11	Tabor St.	Dry	Dry	--	--	--
B-12	Enid St.	Dry	Dry	--	--	--
B-13	Eichwurzel Ln.	Dry	Dry	--	--	--
B-14	Eichwurzel Ln.	14’	13’	--	--	--
B-15	Eichwurzel Ln.	Dry	Dry	--	--	--
B-16	Robert Lee Rd.	Dry	Dry	--	--	--
B-17 (PZ-3)	Robert Lee Rd.	11.5’	11’	(3/06/2013) 11’	(3/14/2013) 10’	(4/10/ 2013) 9.5’
B-18	Leon St.	Dry	Dry	--	--	--
B-19	Delany St.	14’	14.5’	--	--	--
B-20 (PZ-2)	Delany St.	Dry	Dry	(3/06/2013) Dry	(3/14/2013) 10.5’	(4/10/ 2013) 10’
B-21	Link Rd.	Dry	Dry	--	--	--
B-22 (PZ-4)	Link Rd. at White Oak Bayou	24’	23’	(3/02/2013) 23’	(3/14/2013) 22’	(4/10/ 2013) 22.5’
B-23	Enid St. at White Oak Bayou	24’	21.5’	--	--	--
B-24	Link St. at White Oak Bayou	23’	21’	--	--	--
B-25	Link Rd.	Dry	Dry	--	--	--
B-26	Link Rd.	Dry	Dry	--	--	--
B-27	Dunlop St.	Dry	Dry	--	--	--
B-28	Karcher St.	Dry	Dry	--	--	--
B-29	Wynne St.	Dry	Dry	--	--	--
B-30	Wynne St.	Dry	Dry	--	--	--
B-31	Tarver St.	Dry	Dry	--	--	--
B-32	Cavalcade St.	Dry	Dry	--	--	--
B-33	Cortlandt St.	Dry	Dry	--	--	--
B-34	Arlington St.	Dry	Dry	--	--	--
B-35	Arlington St.	Dry	Dry	--	--	--
B-36	Aurora St.	Dry	Dry	--	--	--
B-37	Cortlandt St.	Dry	Dry	--	--	--
B-38	Cortlandt St.	Dry	Dry	--	--	--
B-39	Arlington St.	Dry	Dry	--	--	--
B-40	Arlington St.	14’	14’	--	--	--

TABLE 2

SUMMARY OF GROUNDWATER MEASUREMENTS
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
HOUSTON, TEXAS
WBS NO. S-000035-0182-3
ATL PROJECT NO. G13-120

Boring Number	Location	Ground Water During Drilling	Ground Water Upon Completion of Drilling	Ground Water in Piezometer (after 24 hrs)	Ground Water in Piezometer (after 7 days)	Ground Water in Piezometer (after 30 days)
B-41	Arlington St.	Dry	Dry	--	--	--
B-42 (PZ-5)	Aurora St.	Dry	Dry	(3/07/2013) Dry	(3/14/2013) 5.5’	(4/10/ 2013) 4.5’
B-43	Oxford St.	Dry	Dry	--	--	--
B-44	Oxford St.	Dry	Dry	--	--	--
B-45	E. 22nd St.	Dry	Dry	--	--	--
B-46	Aurora St.	Dry	Dry	--	--	--
B-47	Sheldon St.	Dry	Dry	--	--	--
B-48	E. 20th St.	Dry	Dry	--	--	--
B-49	E. 20th St.	Dry	Dry	--	--	--
B-50	E. 20th St.	Dry	Dry	--	--	--
B-51 (PZ-6)	E. 20th St.	Dry	Dry	(3/07/2013) Dry	(3/14/2013) 10’	(4/10/ 2013) 9’
B-52	E. 20th St.	Dry	Dry	--	--	--
B-53	E. 20th St.	Dry	Dry	--	--	--
B-54	Oxford St.	Dry	Dry	--	--	--
B-55	E. 20th St.	Dry	Dry	--	--	--
B-56	Harvard St.	Dry	Dry	--	--	--
B-57	Arlington St.	Dry	Dry	--	--	--
B-58	E. 18th St.	Dry	Dry	--	--	--
B-59	E. 18th St.	15’	Dry	--	--	--
B-60	E. 18th St.	13’	12’	--	--	--
B-61	E. 18th St.	12.5’	12.5’	--	--	--
B-62	Harvard St.	Dry	Dry	--	--	--
B-63	E. 16th St.	Dry	Dry	--	--	--
B-64	E. 16th St.	Dry	Dry	--	--	--
B-65	Arlington St.	Dry	Dry	--	--	--
B-66 (PZ-7)	Arlington St.	Dry	Dry	(3/07/2013) Dry	(3/14/2013) 6’	(4/10/ 2013) 5’
B-67	Arlington St.	11.5’	9’	--	--	--
B-68	Arlington St.	Dry	Dry	--	--	--
B-69	Arlington St.	14’	Dry	--	--	--
B-70	Arlington St.	Dry	Dry	--	--	--
B-71	E. 12th 1/2 St.	Dry	Dry	--	--	--
B-72	E. 12th 1/2 St.	Dry	Dry	--	--	--
B-73	E. 12th 1/2 St.	Dry	Dry	--	--	--

TABLE 3

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-1	1	0-2	UD		25									2.00	Fat Clay with Sand (CH)
	2	2-4	UD		18		50	19	31	86				2.00	Fat Clay with Sand (CH)
	3	4-6	UD		21									1.50	Fat Clay with Sand (CH)
	4	6-8	UD		20									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		24	100					0.60			2.00	Fat Clay with Sand (CH)
	6	10-12	UD		16		48	18	30					4.00	Lean Clay with Sand (CL)
	7	12-14	UD		16									4.50	Lean Clay with Sand (CL)
B-2	1	0-2	UD		23		51	19	32	78				3.00	Fat Clay with Sand (CH)
	2	2-4	UD		22									2.50	Fat Clay with Sand (CH)
	3	4-6	UD		21									3.00	Fat Clay with Sand (CH)
	4	6-8	UD		20									2.50	fat Clay with Sand (CH)
	5	8-10	UD		23		57	20	37					3.75	Fat Clay with Sand (CH)
	6	10-12	UD		17	120					1.55			4.00	Fat Clay with Sand (CH)
	7	12-13	UD		17									3.25	Fat Clay with Sand (CH)
B-3	1	0-2	UD		19		42	18	24	79				1.50	Lean Clay with Sand (CL
	2	2-4	UD		19									2.00	Lean Clay with Sand (CL
	3	4-6	UD		16									2.75	Lean Clay with Sand (CL
	4	6-8	UD		21									2.75	Lean Clay with Sand (CL
	5	8-10	UD		27	100					0.85			2.50	Fat Clay with Sand (CH)
	6	10-12	UD		18		54	19	35					3.75	Fat Clay with Sand (CH)
	7	12-14	UD		17									3.50	Fat Clay with Sand (CH)
	8	14-16	UD		18	113						1.35(0.72)		4.00	Fat Clay with Sand (CH)
	9	16-17	UD		25									4.00	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-4	1	0-2	UD		16		41	17	24	72				1.50	Lean Clay with Sand (CL) fill
	2	2-4	UD		17									1.50	Lean Clay with Sand (CL) fill
	3	4-6	UD		19	106					0.50			2.00	Lean Clay with Sand (CL) fill
	4	6-8	UD		18									1.50	Lean Clay with Sand (CL) fill
	5	8-10	UD		19									2.00	Lean Clay with Sand (CL) fill
	6	10-12	UD		17		40	17	23					3.50	Lean Clay with Sand (CL) fill
	7	12-14	UD		17									4.00	Lean Clay with Sand (CL) fill
	8	14-15	UD		18	113					1.40			3.50	Lean Clay with Sand (CL) fill
B-5	1	0-2	UD		19									1.75	Fat Clay with Sand (CH)
	2	2-4	UD		18									1.75	Fat Clay with Sand (CH)
	3	4-6	UD		21		53	19	34	78				2.50	Fat Clay with Sand (CH)
	4	6-8	UD		21									2.50	Fat Clay with Sand (CH)
	5	8-10	UD		23									2.50	Fat Clay with Sand (CH)
	6	10-12	UD		17	116					1.35			3.50	Lean Clay with Sand (CL)
	7	12-14	UD		16		47	18	29					4.50	Lean Clay with Sand (CL)
B-6	1	0-2	UD		20									1.50	Fat Clay with Sand (CH)
	2	2-4	UD		18		50	19	31	83				2.00	Fat Clay with Sand (CH)
	3	4-6	UD		19									1.75	Fat Clay with Sand (CH)
	4	6-8	UD		20									1.50	Fat Clay with Sand (CH)
	5	8-10	UD		22	104					0.85			2.50	Fat Clay with Sand (CH)
	6	10-12	UD		23		53	19	34					1.50	Fat Clay with Sand (CH)
	7	12-14	UD		17									3.00	Fat Clay with Sand (CH)
	8	14-15	UD		15									4.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-7	1	0-2	UD		17		31	16	15	80				1.50	Lean Clay with Sand (CL)
	2	2-4	UD		15									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		18									1.50	Lean Clay with Sand (CL)
	4	6-8	UD		17									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		20		56	20	36					2.00	Fat Clay withSand (CH)
	6	10-12	UD		29	97					0.45			1.50	Fat Clay withSand (CH)
	7	12-13	UD		19									1.00	Fat Clay withSand (CH)
B-8	1	0-2	UD		18		42	18	24	83				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		19									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		18									1.50	Lean Clay with Sand (CL)
	4	6-8	UD		19									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		18		54	19	35					2.00	Fat Clay with Sand (CH)
	6	10-12	UD		16	119					0.95			2.50	Fat Clay with Sand (CH)
	7	12-14	UD		20									3.00	Fat Clay with Sand (CH)
B-9	1	0-2	UD		16									2.00	Lean Clay with Sand (CL)
	2	2-4	UD		19									3.75	Lean Clay with Sand (CL)
	3	4-6	UD		15		48	18	30	78				2.75	Lean Clay with Sand (CL)
	4	6-8	UD		12									4.50	Lean Clay with Sand (CL)
	5	8-10	UD		13									4.50	Lean Clay with Sand (CL)
	6	10-12	UD		13	121					2.05			4.50	Lean Clay with Sand (CL)
	7	12-14	UD		14	118	43	18	25	85		2.62(0.65)		4.50	Lean Clay with Sand (CL)
	8	14-16	UD		22									4.50	Lean Clay with Sand (CL)
	9	16-17	UD		17									4.00	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-10	1	0-2	UD		15									3.00	Lean Clay with Sand (CL)
	2	2-4	UD		13	117					0.65			2.00	Lean Clay with Sand (CL)
	3	4-6	UD		11		33	16	17					3.25	Lean Clay with Sand (CL)
	4	6-8	UD		12									4.00	Lean Clay with Sand (CL)
	5	8-10	UD		21									3.50	Lean Clay with Sand (CL)
	6	10-12	UD		16									3.50	Lean Clay with Sand (CL)
	7	12-14	UD		17	116					2.15			4.50	Lean Clay with Sand (CL)
	8	14-16	UD		19									4.50	Lean Clay with Sand (CL)
	9	16-18	UD		17		54	19	35	95				4.00	Fat Clay (CH)
B-11	1	0-2	UD		10									4.50	Lean Clay with Sand (CL)
	2	2-4	UD		12									4.50	Lean Clay with Sand (CL)
	3	4-6	UD		16		43	18	25	73				3.00	Lean Clay with Sand (CL)
	4	6-8	UD		16									4.00	Lean Clay with Sand (CL)
	5	8-10	UD		16									3.50	Lean Clay with Sand (CL)
	6	10-12	UD		17	114					1.70			4.00	Lean Clay with Sand (CL)
	7	12-14	UD		16		46	18	28					2.75	Lean Clay with Sand (CL)
B-12	1	0-2	UD		17									2.00	Lean Clay with Sand (CL)
	2	2-4	UD		17		39	17	22	79				1.75	Lean Clay with Sand (CL)
	3	4-6	UD		15									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		16									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		19	112					1.40			3.50	Lean Clay with Sand (CL)
	6	10-12	UD		24		74	23	51					2.75	Fat Clay with Sand (CH)
	7	12-14	UD		15									4.50	Fat Clay with Sand (CH)
	8	14-15	UD		17									4.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-13	1	0-2	UD		17		45	18	27	76				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		16									1.75	Lean Clay with Sand (CL)
	3	4-6	UD		15									1.50	Lean Clay with Sand (CL)
	4	6-8	UD		19									3.50	Lean Clay with Sand (CL)
	5	8-10	UD		25		64	21	43					3.25	Fat Clay with Sand (CH)
	6	10-12	UD		21									4.00	Fat Clay with Sand (CH)
	7	12-14	UD		23	105					1.60			4.00	Fat Clay with Sand (CH)
B-14	1	0-2	UD		21									1.00	Fat Clay with Sand (CH)
	2	2-4	UD		19		56	20	36	72				1.50	Fat Clay with Sand (CH)
	3	4-6	UD		20									2.00	Fat Clay with Sand (CH)
	4	6-8	UD		19									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		25									1.50	Fat Clay with Sand (CH)
	6	10-12	UD		24		56	20	36					1.50	Fat Clay with Sand (CH)
	7	12-14	UD		18	108					0.45			1.50	Fat Clay with Sand (CH)
	8	14-16	UD		18									1.00	Fat Clay with Sand (CH)
B-15	1	0-2	AU		15										Silty Sand (SM)
	2	2-4	UD		13		32	16	16	52				4.50	Sandy Lean Clay (CL)
	3	4-6	UD		13									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		13									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		16		40	17	23					4.00	Sandy Lean Clay (CL)
	6	10-12	UD		28	97					0.30			1.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-16	1	0-2	UD		19		43	18	25	81				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		20	107					0.35			1.00	Lean Clay with Sand (CL)
	3	4-6	UD		19									1.00	Lean Clay with Sand (CL)
	4	6-8	UD		19									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		30		70	22	48					1.50	Fat Clay (CH)
	6	10-12	UD		22									2.00	Fat Clay (CH)
	7	12-13	SS	15	24										Silty Sand (SM)
B-17	1	0-2	UD		19		50	19	31	72				1.50	Fat Clay with Sand (CH)
	2	2-4	UD		17									4.00	Fat Clay with Sand (CH)
	3	4-6	UD		23									2.50	Fat Clay with Sand (CH)
	4	6-8	UD		26									2.75	Fat Clay with Sand (CH)
	5	8-10	UD		29	95					0.85			2.50	Fat Clay with Sand (CH)
	6	10-12	UD		29									2.00	Fat Clay with Sand (CH)
	7	12-14	UD		38	87						0.61(0.65)		1.00	Fat Clay with Sand (CH)
	8	14-16	SS	10	25										Silty Sand (SM)
	9	16-18	SS	15	24					46					Silty Sand (SM)
	10	18-20	SS	13	23										Silty Sand (SM)
	11	21-23	UD		22		50	19	31	92				4.50	Fat Clay (CH)
B-18	1	0-2	UD		18									1.50	Lean Clay with Sand (CL)
	2	2-4	UD		16		34	16	18	76				2.00	Lean Clay with Sand (CL)
	3	4-6	UD		14									4.00	Lean Clay with Sand (CL)
	4	6-8	UD		13									4.00	Lean Clay with Sand (CL)
	5	8-10	UD		14									4.00	Lean Clay with Sand (CL)
	6	10-12	UD		24		56	20	36	98				4.00	Fat Clay (CH)
	7	12-14	UD		28	98					1.30			3.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-19	1	0-2	UD		15									2.00	Sandy Lean Clay (CL)
	2	2-4	UD		19		35	16	19	56				1.50	Sandy Lean Clay (CL)
	3	4-6	UD		17									1.50	Sandy Lean Clay (CL)
	4	6-8	UD		17									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		18									3.75	Sandy Lean Clay (CL)
	6	10-12	UD		35		76	23	53					1.50	Fat clay with Sand (CH)
	7	12-14	UD		30	92					0.70			2.00	Fat clay with Sand (CH)
	8	14-16	UD		18	114						1.25(0.72)		3.00	Fat clay with Sand (CH)
	9	16-17	UD		17									4.00	Fat clay with Sand (CH)
B-20	1	0-2	AU		10										Silty Sand (SM)
	2	2-4	AU		11					31					Silty Sand (SM)
	3	4-6	UD		13		45	18	27	54				3.50	Sandy Lean Clay (CL)
	4	6-8	UD		10									1.00	Sandy Lean Clay (CL)
	5	8-10	UD		13	116	27	15	12		0.40			1.50	Sandy Lean Clay (CL)
	6	10-12	SS	17	19										Silty Sand (SM)
	7	12-14	SS	23	19										Silty Sand (SM)
	8	14-16	SS	25	21					15					Silty Sand (SM)
	9	16-17	SS	28	22										Silty Sand (SM)
B-21	1	0-2	UD		17		41	17	24	72				4.50	Lean Clay with Sand (CL)
	2	2-4	UD		14									4.50	Lean Clay with Sand (CL)
	3	4-6	UD		12									4.50	Lean Clay with Sand (CL)
	4	6-8	UD		13									4.50	Lean Clay with Sand (CL)
	5	8-10	UD		21	107					1.85			4.00	Lean Clay with Sand (CL)
	6	10-12	UD		17		34	16	18					2.50	Lean Clay with Sand (CL)
	7	12-14	UD		17	112						0.76(0.65)		3.00	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-22	1	0-2	AU		14										Lean Clay with Sand (CL)
	2	2-4	UD		16	105	36	17	19	73	0.50			2.00	Lean Clay with Sand (CL)
	3	4-6	UD		14									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		16		42	18	24	83				2.00	Lean Clay with Sand (CL)
	5	8-10	UD		14									3.00	Lean Clay with Sand (CL)
	6	10-12	UD		16									3.50	Lean Clay with Sand (CL)
	7	12-14	UD		14									4.00	Lean Clay with Sand (CL)
	8	14-16	UD		18		58	20	38	90				4.50	Fat Clay with Sand (CH)
	9	16-18	UD		18	113					2.25			4.50	Fat Clay with Sand (CH)
	10	18-20	UD		20									4.50	Fat Clay with Sand (CH)
	11	23-25	UD		20		30	16	14	95				0.50	Lean Clay (CL)
	12	28-30	UD		24		52	19	33					2..5	Fat Clay (CH)
	13	33-35	UD		26	100					1.85			4.25	Fat Clay (CH)
	14	38-40	UD		26									4.50	Fat Clay (CH)
	15	43-45	UD		23		70	22	48	96				4.50	Fat Clay (CH)
	16	48-50	UD		22	106					1.00			3.50	Fat Clay (CH)
	17	53-55	UD		25									4.50	Fat Clay (CH)
	18	58-60	UD		31									4.50	Fat Clay (CH)
	19	63-65	UD		37	88						1.19(3.02)		3.00	Fat Clay (CH)
	20	68-70	UD		26		63	21	42	96				4.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-23	1	0-2	AU		14		45	18	27	71					Lean Clay withSand (CL) fill
	2	2-4	UD		17	110					0.85			2.00	Lean Clay withSand (CL) fill
	3	4-6	UD		17									3.50	Lean Clay withSand (CL) fill
	4	6-8	UD		17		41	17	24	82				2.50	Lean Clay withSand (CL) fill
	5	8-10	UD		18	111	37	17	20	78	0.50			2.00	Lean Clay withSand (CL) fill
	6	10-12	UD		20									1.50	Lean Clay withSand (CL) fill
	7	12-14	UD		22	99	40	17	23	75		0.23(0.65)		1.00	Lean Clay withSand (CL) fill
	8	14-16	UD		24									1.00	Lean Clay withSand (CL) fill
	9	16-18	UD		23		69	22	47					4.50	Fat Clay with Sand (CH)
	10	18-20	UD		20									4.50	Fat Clay with Sand (CH)
	11	23-25	UD		23	104						0.87(1.15)		2.00	Fat Clay with Sand (CH)
	12	28-30	UD		23		27	15	12	99				2.00	Lean Clay withSand (CL)
	13	33-35	UD		23		63	21	42	97				4.50	Fat Clay (CH)
	14	38-40	UD		26	101					0.65			2.00	Fat Clay (CH)
	15	43-45	UD		19		71	22	49	96				4.50	Fat Clay (CH)
	16	48-50	UD		22									4.50	Fat Clay (CH)
	17	53-55	UD		25	101					2.00			4.50	Fat Clay (CH)
	18	58-60	UD		27									4.50	Fat Clay (CH)
	19	63-65	UD		33		74	23	51	97				4.50	Fat Clay (CH)
	20	68-70	UD		29	96						1.90(3.46)		4.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-24	1	0-2	AU		12		33	16	17	53					Sandy Lean Clay (CL) Fill
	2	2-4	AU		12										Sandy Lean Clay (CL) Fill
	3	4-6	UD		14		34	16	18	54				3.00	Sandy Lean Clay (CL) Fill
	4	6-8	UD		15	97					0.35			1.00	Sandy Lean Clay (CL) Fill
	5	8-10	UD		15	109						0.62(0.43)		2.00	Sandy Lean Clay (CL) Fill
	6	10-12	UD		24		62	21	41	90				1.50	Fat Clay (CH) fill
	7	12-14	UD		19	105					0.35			1.00	Fat Clay (CH) fill
	8	14-16	UD		17									2.50	Fat Clay (CH) fill
	9	16-18	UD		16		41	17	24	84				3.00	Lean Clay with Sand (CL)fill
	10	18-20	UD		20	110						0.38(0.94)		1.00	Lean Clay with Sand (CL)fill
	11	23-25	UD		15		33	16	17	71				1.50	Lean Clay with Sand (CL)fill
	12	28-30	UD		26	104	27	15	12	84		1.84(1.44)		1.00	Lean Clay with Sand (CL)fill
	13	33-35	UD		22		56	20	36					4.50	Fat Clay (CH)
	14	38-40	UD		26	103					1.20			3.50	Fat Clay (CH)
	15	43-45	UD		25		66	21	45	99				4.00	Fat Clay (CH)
	16	48-50	UD		30	96					1.75			4.00	Fat Clay (CH)
	17	53-55	UD		28									4.50	Fat Clay (CH)
	18	58-60	UD		27		79	23	56	98				4.50	Fat Clay (CH)
	19	63-65	UD		34	91					2.00			4.50	Fat Clay (CH)
	20	68-70	UD		30									4.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-25	1	0-2	UD		18									2.75	Fat Clay with Sand (CH)
	2	2-4	UD		22		55	18	37	77				2.50	Fat Clay with Sand (CH)
	3	4-6	UD		28									1.50	Fat Clay with Sand (CH)
	4	6-8	UD		31									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		26	100					0.55			2.00	Fat Clay with Sand (CH)
	6	10-12	UD		21		52	19	33					1.50	Fat Clay with Sand (CH)
	7	12-13	SS	15	20										Silty Sand (SM)
B-26	1	0-2	UD		18									2.75	Fat Clay (CH)
	2	2-4	UD		15									3.50	Fat Clay (CH)
	3	4-6	UD		17		55	20	35	95				4.00	Fat Clay (CH)
	4	6-8	UD		20									3.75	Fat Clay (CH)
	5	8-10	UD		20	106					0.60			2.00	Fat Clay (CH)
	6	10-12	UD		26									3.00	Fat Clay (CH)
	7	12-14	UD		25		64	21	43	96				3.5	Fat Clay (CH)
	8	14-15	UD		20									4.00	Fat Clay (CH)
B-27	1	0-2	UD		14		24	15	9	85				3.50	Lean Clay with Sand (CL)
	2	2-4	UD		18									2.75	Lean Clay with Sand (CL)
	3	4-6	UD		16									3.75	Lean Clay with Sand (CL)
	4	6-8	UD		15									3.25	Lean Clay with Sand (CL)
	5	8-10	UD		20	108						0.97(0.43)		4.00	Lean Clay with Sand (CL)
	6	10-12	UD		25	104	49	19	30		0.85			2.00	Lean Clay with Sand (CL)
	7	12-14	UD		22									0.50	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-28	1	0-2	UD		21									1.50	Fat Clay with Sand (CH)
	2	2-4	UD		23									1.50	Fat Clay with Sand (CH)
	3	4-6	UD		20		53	19	34	78				2.00	Fat Clay with Sand (CH)
	4	6-8	UD		21									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		39									2.00	Fat Clay with Sand (CH)
	6	10-12	UD		25		30	16	14					2.00	Sandy Lean Clay (CL)
	7	12-14	UD		26	104					0.35			1.00	Sandy Lean Clay (CL)
B-29	1	0-2	UD		7		28	15	13	74				4.50	Sandy Lean Clay (CL)
	2	2-4	UD		11									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		13									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		14									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		14		47	18	29					4.50	Sandy Lean Clay (CL)
	6	10-12	UD		21	105					0.55			2.00	Sandy Lean Clay (CL)
	7	12-13	UD		22									2.00	Sandy Lean Clay (CL)
B-30	1	0-2	UD		17		37	20	17	86				2.00	Lean Clay (CL)
	2	2-4	UD		19									1.75	Lean Clay (CL)
	3	4-6	UD		22									1.00	Lean Clay (CL)
	4	6-8	UD		22									1.00	Lean Clay (CL)
	5	8-10	UD		29		61	21	40					1.00	Fat Clay (CH)
	6	10-12	UD		31	94					0.65			2.00	Fat Clay (CH)
	7	12-14	UD		23		91	25	66	94				3.00	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-31	1	0-2	UD		13		24	15	9	72				4.00	Lean Clay with Sand (CL)
	2	2-4	UD		16									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		15									4.50	Lean Clay with Sand (CL)
	4	6-8	UD		16									3.75	Lean Clay with Sand (CL)
	5	8-10	UD		18		48	18	30					3.00	Lean Clay with Sand (CL)
	6	10-12	UD		20	111					1.45			3.50	Lean Clay with Sand (CL)
B-32	1	0-2	UD		19		44	18	26	96				3.50	Lean Clay (CL) (Fill)
	2	2-4	UD		18									3.00	Lean Clay (CL) (Fill)
	3	4-6	UD		18									4.50	Lean Clay (CL) (Fill)
	4	6-8	UD		13									4.50	Lean Clay (CL) (Fill)
	5	8-10	UD		15									4.50	Lean Clay (CL) (Fill)
	6	10-12	UD		17	108	48	18	30		1.20			3.50	Lean Clay (CL) (Fill)
	7	12-13	UD		13									4.50	Lean Clay (CL) (Fill)
B-33	1	0-2	UD		16		33	16	17	85				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		18									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		18									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		18									1.50	Lean Clay with Sand (CL)
	5	8-10	UD		19		51	19	32					2.00	Fat Clay with Sand (CH)
	6	10-12	UD		20	110					0.80			2.00	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-34	1	0-2	UD		17		31	16	15	80				2.50	Lean Clay with Sand (CL)
	2	2-4	UD		18									2.75	Lean Clay with Sand (CL)
	3	4-6	UD		17									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		17									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		19	113					1.00			3.50	Lean Clay with Sand (CL)
	6	10-12	UD		26		59	20	39					3.50	Fat Clay with Sand (CH)
	7	12-13	UD		18									4.00	Fat Clay with Sand (CH)
B-35	1	0-2	UD		17									2.00	Lean Clay with Sand (CL)
	2	2-4	UD		17		34	16	18	76				2.00	Lean Clay with Sand (CL)
	3	4-6	UD		16									1.50	Lean Clay with Sand (CL)
	4	6-8	UD		21									1.00	Lean Clay with Sand (CL)
	5	8-10	UD		22									1.00	Lean Clay with Sand (CL)
	6	10-12	UD		23									2.00	Lean Clay with Sand (CL)
	7	12-14	UD		16		40	17	23					3.50	Lean Clay with Sand (CL)
	8	14-16	UD		17	119					1.50			4.00	Lean Clay with Sand (CL)
B-36	1	0-2	UD		17		36	17	19	67				2.00	Sandy Lean Clay (CL)
	2	2-4	UD		19									1.50	Sandy Lean Clay (CL)
	3	4-6	UD		17									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		19									3.00	Sandy Lean Clay (CL)
	5	8-10	UD		27		62	21	41					2.00	Fat Clay with Sand (CH)
	6	10-12	UD		22	107					0.85			2.00	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-37	1	0-2	UD		18									2.00	Sandy Lean Clay (CL)
	2	2-4	UD		16	113					0.45			1.50	Sandy Lean Clay (CL)
	3	4-6	UD		17		43	18	25	82				2.00	Sandy Lean Clay (CL)
	4	6-8	UD		19									2.00	Sandy Lean Clay (CL)
	5	8-10	UD		21									1.50	Sandy Lean Clay (CL)
	6	10-12	UD		21	108					0.60			2.00	Sandy Lean Clay (CL)
	7	12-14	UD		15		41	17	24	80				3.75	Sandy Lean Clay (CL)
	8	14-16	UD		16									3.00	Sandy Lean Clay (CL)
B-38	1	0-2	UD		15		42	18	24	85				3.50	Lean Clay with Sand (CL)
	2	2-4	UD		18									3.00	Lean Clay with Sand (CL)
	3	4-6	UD		19									2.75	Lean Clay with Sand (CL)
	4	6-8	UD		17									4.00	Lean Clay with Sand (CL)
	5	8-10	UD		19	110					1.40			3.50	Lean Clay with Sand (CL)
	6	10-12	UD		18		32	16	16					3.50	Lean Clay with Sand (CL)
	7	12-14	UD		18									3.00	Lean Clay with Sand (CL)
B-39	1	0-2	UD		13									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		13	118					1.05			3.50	Sandy Lean Clay (CL)
	3	4-6	UD		12		33	16	17	67				3.00	Sandy Lean Clay (CL)
	4	6-8	UD		17									3.50	Sandy Lean Clay (CL)
	5	8-10	UD		19									4.00	Sandy Lean Clay (CL)
	6	10-12	UD		25									2.50	Sandy Lean Clay (CL)
	7	12-14	UD		18	115					1.55			4.00	Sandy Lean Clay (CL)
	8	14-16	UD		18		49	19	30	69				3.50	Sandy Lean Clay (CL)
	9	16-17	UD		19									4.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-40	1	0-2	UD		17		31	16	15	71				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		18									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		18	112					0.85			2.00	Lean Clay with Sand (CL)
	4	6-8	UD		20									2.50	Lean Clay with Sand (CL)
	5	8-10	UD		19									2.50	Lean Clay with Sand (CL)
	6	10-12	UD		21		52	19	33	84				1.50	Fat Clay with Sand (CH)
	7	12-14	UD		21	107					0.75			2.00	Fat Clay with Sand (CH)
	8	14-16	UD		18									4.00	Fat Clay with Sand (CH)
B-41	1	0-2	UD		18									1.50	Lean Clay with Sand (CL)
	2	2-4	UD		19	107					0.60			2.00	Lean Clay with Sand (CL)
	3	4-6	UD		18		41	17	24	84				2.50	Lean Clay with Sand (CL)
	4	6-8	UD		18									3.00	Lean Clay with Sand (CL)
	5	8-10	UD		18									2.50	Lean Clay with Sand (CL)
	6	10-12	UD		18	114					1.20			3.50	Lean Clay with Sand (CL)
	7	12-14	UD		20		43	18	25					3.00	Lean Clay with Sand (CL)
	8	14-16	UD		19									3.00	Lean Clay with Sand (CL)
B-42	1	0-2	UD		16		39	17	22	73				3.00	Lean Clay with Sand (CL)
	2	2-4	UD		14									3.00	Lean Clay with Sand (CL)
	3	4-6	UD		18									3.50	Lean Clay with Sand (CL)
	4	6-8	UD		21									2.50	Lean Clay with Sand (CL)
	5	8-10	UD		21	106					1.05			4.00	Lean Clay with Sand (CL)
	6	10-12	UD		17		47	18	29	80				3.50	Lean Clay with Sand (CL)
	7	12-14	UD		17									4.50	Lean Clay with Sand (CL)
	8	14-16	UD		18	114						1.90(0.72)		4.50	Lean Clay with Sand (CL)
	9	16-17	UD		19									2.50	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0183-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-43	1	0-2	UD		14		31	16	15	76				1.50	Lean Clay with Sand (CL)
	2	2-4	UD		17									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		16									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		19									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		19	110					0.90			2.50	Lean Clay with Sand (CL)
	6	10-12	UD		17		37	17	20					3.00	Lean Clay with Sand (CL)
	7	12-14	UD		15									4.00	Lean Clay with Sand (CL)
B-44	1	0-2	UD		21									1.50	Lean Clay with Sand (CL)
	2	2-4	UD		19		37	17	20	74				1.50	Lean Clay with Sand (CL)
	3	4-6	UD		19									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		17									3.00	Lean Clay with Sand (CL)
	5	8-10	UD		18									2.50	Lean Clay with Sand (CL)
	6	10-12	UD		15		43	18	25					3.00	Lean Clay with Sand (CL)
	7	12-14	UD		15	123					1.60			4.00	Lean Clay with Sand (CL)
B-45	1	0-2	UD		19		33	16	17	84				1.50	Lean Clay with Sand (CL)
	2	2-4	UD		18									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		18									1.00	Lean Clay with Sand (CL)
	4	6-8	UD		22									1.00	Lean Clay with Sand (CL)
	5	8-10	UD		21		46	18	28					1.50	Lean Clay with Sand (CL)
	6	10-12	UD		21	106					0.75			2.00	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-46	1	0-2	UD		15		31	16	15	71				3.00	Lean Clay with Sand (CL)
	2	2-4	UD		13									4.50	Lean Clay with Sand (CL)
	3	4-6	UD		18									1.75	Lean Clay with Sand (CL)
	4	6-8	UD		13									4.50	Lean Clay with Sand (CL)
	5	8-10	UD		15		45	18	27					4.50	Lean Clay with Sand (CL)
	6	10-12	UD		17	112					1.45			3.50	Lean Clay with Sand (CL)
	7	12-14	UD		15									4.50	Lean Clay with Sand (CL)
	8	14-16	UD		22	110						1.02(0.72)		3.00	Lean Clay with Sand (CL)
B-47	1	0-2	UD		15									3.75	Sandy Lean Clay (CL)
	2	2-4	UD		16		32	16	16	67				2.75	Sandy Lean Clay (CL)
	3	4-6	UD		17									2.50	Sandy Lean Clay (CL)
	4	6-8	UD		21									1.00	Sandy Lean Clay (CL)
	5	8-10	UD		24	96					0.20			0.75	Sandy Lean Clay (CL)
	6	10-12	UD		25									0.50	Sandy Lean Clay (CL)
	7	12-14	UD		23		29	15	14	53				0.50	Sandy Lean Clay (CL)
	8	14-15	UD		30									1.00	Sandy Lean Clay (CL)
B-48	1	0-2	UD		17		24	15	9	88				1.50	Lean Clay (CL)
	2	2-4	UD		20									1.50	Lean Clay (CL)
	3	4-6	UD		17		42	18	24					3.00	Lean Clay (CL)
	4	6-8	UD		18									4.00	Lean Clay (CL)
	5	8-10	UD		18		50	19	31	91				3.50	Fat Clay (CH)
	6	10-12	UD		23	103					0.90			2.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-49	1	0-2	UD		20									1.00	Lean Clay (CL)
	2	2-4	UD		20		36	17	19	97				1.00	Lean Clay (CL)
	3	4-6	UD		17									1.50	Lean Clay (CL)
	4	6-8	UD		19									2.00	Lean Clay (CL)
	5	8-10	UD		17									1.50	Lean Clay (CL)
	6	10-12	UD		20		45	18	27					2.00	Lean Clay (CL)
	7	12-14	SS	9	23					47					Silty Sand (SM)
	8	14-16	UD		34	87					0.60			2.00	Fat Clay (CH)
B-50	1	0-2	UD		21									1.00	Lean Clay with Sand
	2	2-4	UD		19		47	18	29	83				1.50	Lean Clay with Sand
	3	4-6	UD		21									1.75	Lean Clay with Sand
	4	6-8	UD		21									2.00	Lean Clay with Sand
	5	8-10	UD		22	108					0.95			2.50	Lean Clay with Sand
	6	10-12	UD		32		67	21	46					1.50	Fat Clay with Sand (CH)
	7	12-13	UD		24									1.00	Lean Clay with Sand
B-51	1	0-2	UD		17									3.00	Sandy Lean Clay (CL)
	2	2-4	UD		12		32	16	16	62				4.00	Sandy Lean Clay (CL)
	3	4-6	UD		17									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		18									3.00	Sandy Lean Clay (CL)
	5	8-10	UD		20									3.50	Sandy Lean Clay (CL)
	6	10-12	UD		19	109					0.65			2.00	Sandy Lean Clay (CL)
	7	12-14	UD		30		80	24	56	94				4.00	Fat Clay (CH)
	8	14-16	UD		28									3.50	Fat Clay (CH)
	9	16-18	UD		28	95						0.71 (0.79)		4.00	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-52	1	0-2	UD		20									2.00	Fat Clay (CH)
	2	2-4	UD		19									2.00	Fat Clay (CH)
	3	4-6	UD		20		51	19	32	86				2.00	Fat Clay (CH)
	4	6-8	UD		10									2.00	Fat clay (CH)
	5	8-10	UD		23									1.50	Fat Clay (CH)
	6	10-12	UD		21									1.50	Fat Clay (CH)
	7	12-14	UD		21	106	43	18	25		0.85			2.50	Sandy Lean Clay (CL)
	8	14-15	UD		22									3.50	Sandy Lean Clay (CL)
B-53	1	0-2	UD		15		37	17	20	79				2.00	Lean Clay with Sand (CL)
	2	2-4	UD		15	116					0.75			2.00	Lean Clay with Sand (CL)
	3	4-6	UD		20									4.00	Lean Clay with Sand (CL)
	4	6-8	UD		23									1.50	Lean Clay with Sand (CL)
	5	8-10	UD		19									1.00	Lean Clay with Sand (CL)
	6	10-12	UD		20		46	18	28	83				2.00	Lean Clay with Sand (CL)
	7	12-14	UD		22									4.50	Lean Clay with Sand (CL)
	8	14-15	UD		24									4.50	Lean Clay with Sand (CL)
B-54	1	0-2	UD		16									2.00	Lean Clay with Sand (CL)
	2	2-4	UD		19		36	17	19	85				1.50	Lean Clay with Sand (CL)
	3	4-6	UD		19									1.00	Lean Clay with Sand (CL)
	4	6-8	UD		19									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		19									1.50	Lean Clay with Sand (CL)
	6	10-12	UD		21		44	18	26					2.00	Lean Clay with Sand (CL)
	7	12-14	UD		21	109					0.40			1.50	Lean Clay with Sand (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-55	1	0-2	UD		19									1.50	Sandy Lean Clay (CL)
	2	2-4	UD		19									2.00	Sandy Lean Clay (CL)
	3	4-6	UD		19		46	18	28	66				2.00	Sandy Lean Clay (CL)
	4	6-8	UD		20									1.50	Sandy Lean Clay (CL)
	5	8-10	UD		28	99					0.65			2.00	Sandy Lean Clay (CL)
	6	10-12	UD		31									2.00	Sandy Lean Clay (CL)
	7	12-14	UD		24		26	15	11	55				1.00	Sandy Lean Clay (CL)
	8	14-15	UD		23									3.50	Sandy Lean Clay (CL)
B-56	1	0-2	UD		22									1.00	Lean Clay with Sand(CL)
	2	2-4	UD		22	104					0.45			1.50	Lean Clay with Sand(CL)
	3	4-6	UD		21		44	18	26	84				2.00	Lean Clay with Sand(CL)
	4	6-8	UD		18									3.50	Lean Clay with Sand(CL)
	5	8-10	UD		18									3.00	Lean Clay with Sand(CL)
	6	10-12	UD		20									3.50	Lean Clay with Sand(CL)
	7	12-14	UD		20	109					0.60			2.00	Lean Clay with Sand(CL)
	8	14-16	UD		31		72	22	50	95				4.00	Fat Clay (CH)
	9	16-18	UD		29									3.00	Fat Clay (CH)
B-57	1	0-2	UD		22		44	18	26	82				1.50	Lean Clay with Sand (CL)
	2	2-4	UD		19									2.00	Lean Clay with Sand (CL)
	3	4-6	UD		18									1.50	Lean Clay with Sand (CL)
	4	6-8	UD		17									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		18		51	19	32					3.00	Fat Clay (CH)
	6	10-12	UD		23	108					0.70			2.00	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample NO.	Sample DEPTH (ft)	Sample TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	TYPE OF MATERIAL
B-58	1	0-2	UD		16									3.00	Fat Clay (CH)
	2	2-4	UD		12									2.50	Fat Clay (CH)
	3	4-6	UD		21		57	20	37	95				3.00	Fat Clay (CH)
	4	6-8	UD		20									3.50	Fat clay (CH)
	5	8-10	UD		22									3.50	Fat Clay (CH)
	6	10-12	UD		27									2.50	Fat Clay (CH)
	7	12-14	UD		25									3.00	Fat Clay (CH)
	8	14-16	UD		25		63	21	42	99				2.50	Fat Clay (CH)
	9	16-18	UD		22	105					0.95			2.50	Fat Clay (CH)
B-59	1	0-2	UD		22									2.00	Fat Clay (CH)
	2	2-4	UD		25	101					0.75			2.00	Fat Clay (CH)
	3	4-6	UD		19		52	19	33	87				2.50	Fat Clay (CH)
	4	6-8	UD		19									2.50	Fat Clay (CH)
	5	8-10	UD		20									2.50	Fat Clay (CH)
	6	10-12	UD		22									3.50	Fat Clay (CH)
	7	12-14	UD		25	96					0.55			2.00	Fat Clay (CH)
	8	14-16	UD		31		78	23	55	96				4.00	Fat Clay (CH)
	9	16-17	UD		27									2.50	Fat Clay (CH)
B-60	1	0-2	UD		17									2.75	Lean Clay (CL)
	2	2-4	UD		14	118					1.10			3.50	Lean Clay (CL)
	3	4-6	UD		21		49	19	30	92				2.00	Lean Clay (CL)
	4	6-8	UD		26									1.75	Lean Clay (CL)
	5	8-10	UD		25									2.50	Lean Clay (CL)
	6	10-12	UD		22	108					1.05			3.50	Lean Clay (CL)
	7	12-14	UD		22		41	17	24	89				2.50	Lean Clay (CL)
	8	14-15	UD		28									3.50	Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-61	1	0-2	UD		14		38	17	21	75				2.50	Lean Clay with Sand (CL)
	2	2-4	UD		16									3.50	Lean Clay with Sand (CL)
	3	4-6	UD		17	113					0.80			2.00	Lean Clay with Sand (CL)
	4	6-8	UD		22									1.50	Lean Clay with Sand (CL)
	5	8-10	UD		23									2.00	Lean Clay with Sand (CL)
	6	10-12	UD		28		65	21	44	98				1.75	Fat Clay (CH)
	7	12-14	UD		23	105					0.40			1.25	Fat Clay (CH)
	8	14-15	UD		16									2.50	Fat Clay (CH)
B-62	1	0-2	UD		20		57	20	37	89				2.50	Fat Clay (CH)
	2	2-4	UD		23									2.75	Fat Clay (CH)
	3	4-6	UD		19									3.00	Fat Clay (CH)
	4	6-8	UD		17									3.50	Fat Clay (CH)
	5	8-10	UD		22		55	20	35					2.50	Fat Clay (CH)
	6	10-12	UD		25	101					0.70			2.00	Fat Clay (CH)
B-63	1	0-2	UD		15									2.00	Lean Clay (CL)
	2	2-4	UD		19	104					0.65			2.00	Lean Clay (CL)
	3	4-6	UD		18		45	18	27	93				1.50	Lean Clay (CL)
	4	6-8	UD		18									2.00	Lean Clay (CL)
	5	8-10	UD		17									3.00	Lean Clay (CL)
	6	10-12	UD		20									3.00	Lean Clay (CL)
	7	12-14	UD		18									2.50	Lean Clay (CL)
	8	14-15	UD		18		41	17	24					3.50	Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-64	1	0-2	UD		13									2.50	Sandy Lean Clay (CL)
	2	2-4	UD		12		33	16	17	64				3.00	Sandy Lean Clay (CL)
	3	4-6	UD		13									3.00	Sandy Lean Clay (CL)
	4	6-8	UD		20									2.50	Sandy Lean Clay (CL)
	5	8-10	UD		31									2.00	Sandy Lean Clay (CL)
	6	10-12	UD		22		36	17	19					2.00	Sandy Lean Clay (CL)
	7	12-13	UD		16	116					0.45			1.50	Sandy Lean Clay (CL)
B-65	1	0-2	UD		29		67	21	46	98				1.75	Fat Clay (CH)
	2	2-4	UD		26									2.00	Fat Clay (CH)
	3	4-6	UD		23									1.75	Fat Clay (CH)
	4	6-8	UD		24									3.50	Fat Clay (CH)
	5	8-10	UD		29		60	20	40					4.00	Fat Clay (CH)
	6	10-12	UD		27	96					0.60			2.00	Fat Clay (CH)
B-66	1	0-2	UD		14									4.50	Lean Clay (CL)
	2	2-4	UD		15		36	17	19	92				4.50	Lean Clay (CL)
	3	4-6	UD		17									4.00	Lean Clay (CL)
	4	6-8	UD		19									3.50	Lean Clay (CL)
	5	8-10	UD		20									2.50	Lean Clay (CL)
	6	10-12	UD		27	98					0.70			2.00	Lean Clay (CL)
	7	12-14	UD		18		23	15	8	86				2.00	Lean Clay (CL)
	8	14-16	UD		16	116						2.18 (0.72)		4.50	Lean Clay (CL)
	9	16-17	UD		16									4.50	Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-67	1	0-2	UD		14		31	16	15	75				3.75	Lean Clay with Sand (CL)
	2	2-4	UD		15									4.00	Lean Clay with Sand (CL)
	3	4-6	UD		15									4.00	Lean Clay with Sand (CL)
	4	6-8	UD		18									2.50	Lean Clay with Sand (CL)
	5	8-10	UD		18		48	18	30					2.00	Lean Clay with Sand (CL)
	6	10-12	UD		17	111					0.30			1.00	Lean Clay with Sand (CL)
	7	12-14	SS	27	21										Silty Sand (SM)
B-68	1	0-2	UD		19		35	16	19	95				1.50	Lean Clay (CL)
	2	2-4	UD		19									3.00	Lean Clay (CL)
	3	4-6	UD		19									3.50	Lean Clay (CL)
	4	6-8	UD		20									4.00	Lean Clay (CL)
	5	8-10	UD		18		45	18	27					4.00	Lean Clay (CL)
	6	10-12	UD		21	104					0.95			2.50	Lean Clay (CL)
B-69	1	0-2	UD		12		35	16	19	84				2.00	Lean Clay (CL)
	2	2-4	UD		12									4.00	Lean Clay (CL)
	3	4-6	UD		16									3.50	Lean Clay (CL)
	4	6-8	UD		19									3.00	Lean Clay (CL)
	5	8-10	UD		18		48	18	30					2.50	Lean Clay (CL)
	6	10-12	UD		18	110					0.60			2.00	Lean Clay (CL)
	7	12-14	SS	18	20					43					Silty Sand (SM)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-70	1	0-2	UD		16									2.50	Lean Clay with Sand (CL)
	2	2-4	UD		17		37	17	20	83				2.50	Lean Clay with Sand (CL)
	3	4-6	UD		17									3.00	Lean Clay with Sand (CL)
	4	6-8	UD		17									3.50	Lean Clay with Sand (CL)
	5	8-10	UD		21									2.75	Lean Clay with Sand (CL)
	6	10-12	UD		22									3.50	Lean Clay with Sand (CL)
	7	12-14	UD		32	93	40	17	23		0.75			2.00	Lean Clay with Sand (CL)
	8	14-15	UD		26									1.00	Lean Clay with Sand (CL)
B-71	1	0-2	UD		19									2.50	Lean Clay w/sand (Fill)
	2	2-4	UD		20									2.50	Lean Clay w/sand (Fill)
	3	4-6	UD		20		45	18	27	71				1.50	Lean Clay with Sand (CL)
	4	6-8	UD		16									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		19	112						1.66 (0.43)		3.00	Lean Clay with Sand (CL)
	6	10-12	UD		18		36	17	19					1.50	Lean Clay with Sand (CL)
	7	12-13	UD		28	93					0.35			1.00	Lean Clay with Sand (CL)
B-72	1	0-2	UD		15		32	16	16	59				2.00	Sandy Lean Clay (CL) fill
	2	2-4	UD		20									1.50	Sandy Lean Clay (CL) fill
	3	4-6	UD		18									1.00	Sandy Lean Clay (CL) fill
	4	6-8	UD		17									1.50	Sandy Lean Clay (CL) fill
	5	8-10	UD		23		62	21	41					2.00	Fat Clay with Sand (CH)
	6	10-12	UD		25	100					0.45			1.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA
COH WBS NO: S-000035-0182-3
CONSULTANT PROJECT NUMBER: G13-120

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-73	1	0-2	UD		19		34	16	18	70				3.00	Lean Clay with Sand (CL)fill
	2	2-4	UD		20									2.50	Lean Clay with Sand (CL)fill
	3	4-6	UD		18									3.00	Lean Clay with Sand (CL)
	4	6-8	UD		17									2.50	Lean Clay with Sand (CL)
	5	8-10	UD		18		51	19	32					3.50	Fat Clay with Sand (CH)
	6	10-12	UD		28	98					0.95			2.50	Fat Clay with Sand (CH)
	7	12-13	UD		22	104						0.66(0.65)		2.00	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 4.1

Marston Soil Coefficients (C_d) for Trench Conduits

A = $K\mu' = .1924$ Granular materials without cohesion

B = $K\mu' = .165$ Maximum for sand and gravel

C = $K\mu' = .150$ Maximum for saturated top soil

D = $K\mu' = .130$ Ordinary maximum for clay

E = $K\mu' = .110$ Maximum for saturated clay

H/B_d	A	B	C	D	E
0.05	0.050	0.050	0.050	0.050	0.050
0.10	0.098	0.098	0.099	0.099	0.099
0.15	0.146	0.146	0.147	0.147	0.148
0.20	0.192	0.194	0.194	0.195	0.196
0.25	0.238	0.240	0.241	0.242	0.243
0.30	0.283	0.286	0.287	0.289	0.290
0.35	0.327	0.331	0.332	0.335	0.337
0.40	0.371	0.375	0.377	0.380	0.383
0.45	0.413	0.418	0.421	0.425	0.428
0.50	0.455	0.461	0.464	0.469	0.473
0.55	0.496	0.503	0.507	0.512	0.518
0.60	0.536	0.544	0.549	0.555	0.562
0.65	0.575	0.585	0.591	0.598	0.606
0.70	0.614	0.625	0.631	0.640	0.649
0.75	0.651	0.664	0.672	0.681	0.691
0.80	0.689	0.703	0.711	0.722	0.734
0.85	0.725	0.741	0.750	0.763	0.775
0.90	0.761	0.779	0.789	0.802	0.817
0.95	0.796	0.816	0.827	0.842	0.857

H/B_d	A	B	C	D	E
3.00	1.780	1.904	1.978	2.083	2.196
3.10	1.810	1.941	2.018	2.128	2.247
3.20	1.840	1.976	2.057	2.172	2.297
3.30	1.869	2.010	2.095	2.215	2.346
3.40	1.896	2.044	2.131	2.257	2.394
3.50	1.923	2.076	2.167	2.298	2.441
3.60	1.948	2.107	2.201	2.338	2.487
3.70	1.973	2.137	2.235	2.376	2.531
3.80	1.997	2.166	2.267	2.414	2.575
3.90	2.019	2.194	2.299	2.451	2.618
4.00	2.041	2.221	2.329	2.487	2.660
4.10	2.062	2.247	2.359	2.522	2.701
4.20	2.082	2.273	2.388	2.556	2.741
4.30	2.102	2.297	2.416	2.589	2.780
4.40	2.121	2.321	2.443	2.621	2.819
4.50	2.139	2.344	2.469	2.652	2.856
4.60	2.156	2.366	2.495	2.683	2.893
4.70	2.173	2.388	2.520	2.713	2.929
4.80	2.189	2.409	2.543	2.742	2.964

CONCRETE PRESSURE PIPE

Source: American Water Works Association, Manual of Water Supply Practices, "Concrete Pressure Pipe, AMMA M9

MARSTON SOIL COEFFICIENTS (C_d) FOR TRENCH CONDUITS	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS NO. S-00035-0182-3	
	PROJECT NO. : G13-120	TABLE 4 (1 of 2)

PST 8/28/12

TABLE 4.1 *(cont)*

H/B_d	A	B	C	D	E
1.00	0.830	0.852	0.864	0.881	0.898
1.05	0.864	0.887	0.901	0.919	0.938
1.10	0.897	0.922	0.937	0.957	0.977
1.15	0.929	0.957	0.973	0.994	1.016
1.20	0.961	0.991	1.008	1.031	1.055
1.25	0.992	1.024	1.042	1.067	1.093
1.30	1.023	1.057	1.076	1.103	1.131
1.35	1.053	1.089	1.110	1.139	1.168
1.40	1.082	1.121	1.143	1.173	1.205
1.45	1.111	1.152	1.176	1.208	1.241
1.50	1.140	1.183	1.208	1.242	1.278
1.55	1.167	1.213	1.240	1.276	1.313
1.60	1.195	1.243	1.271	1.309	1.349
1.65	1.221	1.272	1.301	1.342	1.384
1.70	1.248	1.301	1.332	1.374	1.418
1.75	1.273	1.329	1.361	1.406	1.452
1.80	1.299	1.357	1.391	1.437	1.486
1.85	1.323	1.385	1.420	1.469	1.520
1.90	1.348	1.412	1.448	1.499	1.553
1.95	1.372	1.438	1.476	1.530	1.586
2.00	1.395	1.464	1.504	1.560	1.618
2.10	1.440	1.515	1.558	1.618	1.682
2.20	1.484	1.564	1.610	1.675	1.744
2.30	1.526	1.612	1.661	1.731	1.805
2.40	1.567	1.658	1.711	1.785	1.865
2.50	1.606	1.702	1.759	1.838	1.923
2.60	1.643	1.745	1.805	1.890	1.980
2.70	1.679	1.787	1.850	1.940	2.036
2.80	1.714	1.827	1.894	1.989	2.090
2.90	1.747	1.867	1.937	2.037	2.144

H/B_d	A	B	C	D	E
4.90	2.204	2.429	2.567	2.770	2.999
5.00	2.219	2.448	2.590	2.798	3.032
5.10	2.234	2.467	2.612	2.825	3.065
5.20	2.247	2.486	2.633	2.851	3.098
5.30	2.261	2.503	2.654	2.877	3.129
5.40	2.273	2.520	2.674	2.901	3.160
5.50	2.286	2.537	2.693	2.926	3.190
5.60	2.298	2.553	2.712	2.949	3.220
5.70	2.309	2.568	2.730	2.972	3.248
5.80	2.320	2.583	2.748	2.995	3.277
5.90	2.330	2.598	2.766	3.017	3.304
6.00	2.340	2.612	2.782	3.038	3.331
6.20	2.360	2.639	2.814	3.079	3.383
6.40	2.377	2.664	2.845	3.118	3.433
6.60	2.394	2.687	2.873	3.155	3.481
6.80	2.409	2.709	2.900	3.190	3.527
7.00	2.423	2.730	2.925	3.223	3.571
7.20	2.436	2.749	2.949	3.255	3.613
7.40	2.448	2.767	2.971	3.285	3.653
7.60	2.459	2.784	2.992	3.313	3.691
7.80	2.470	2.799	3.012	3.340	3.728
8.00	2.479	2.814	3.031	3.366	3.763
8.50	2.500	2.847	3.073	3.424	3.845
9.00	2.517	2.875	3.109	3.476	3.918
9.50	2.532	2.898	3.141	3.521	3.983
10.0	2.543	2.919	3.167	3.560	4.042
15.0	2.591	3.009	3.296	3.768	4.378
20.0	2.598	3.026	3.325	3.825	4.490
30.0	2.599	3.030	3.333	3.845	4.539
40.0	2.599	3.030	3.333	3.846	4.545

EXTERNAL LOADING

MARSTON SOIL COEFFICIENTS (C_d) FOR TRENCH CONDUITS	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA	WBS No. S-00035-0182-3
	PROJECT NO. : G13-120 / TABLE 4 (2 of 2)

PST 8/28/12

APPENDIX 1

PHOTOGRAPHS OF THE PROJECT SITE

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G13-120
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No: S-000035-0182-3

Looking North On Eastman Street From Sylvester Road

Looking East On Link Road From Enid Street

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G13-120
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No: S-000035-0182-3

Looking West On Wynne Street From Fulton Street

Looking North On Arlington From East 23rd

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G13-120
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No: S-000035-0182-3

Looking West On Aurora Street From Gostic

Looking West On East 20th street From Oxford

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G13-120
WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No: S-000035-0182-3

Looking North at Enid Street Bridge at Little White Oak Bayou Crossing

Looking West at Link Road Bridge at Little White Oak Bayou Crossing

APPENDIX 2

PIEZOMETER INSTALLATION REPORTS

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-3 (PZ-1)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-5-13

DRY AUGERED 0 TO 17 FT

WASH BORED _____ TO _____ FT

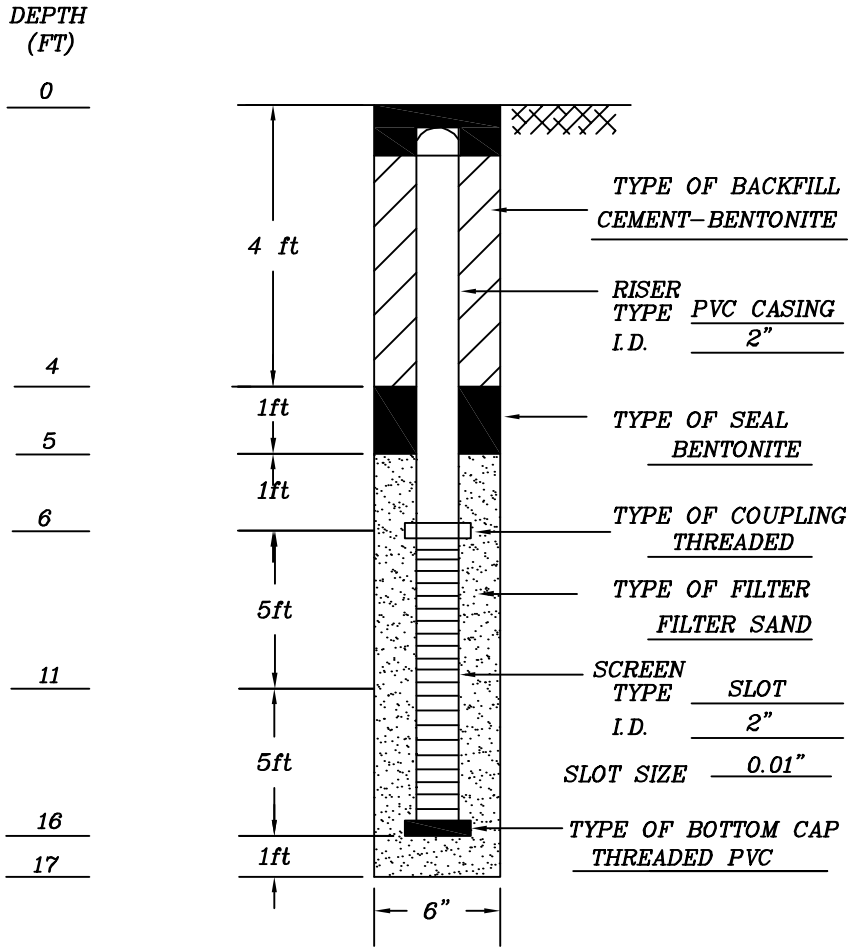
DRILING FLUID: _____

DEVELOPMENT DATE: 3-15-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-6-13	DRY
3-14-13	13'
4-10-13	8'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY:	STARTED:	ATL job No. G13-120
VAN & SON	3-14-13	
LOGGED BY: PV	COMPLETED: 3-14-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 1 OF 7

ASSOCIATED TESTING LABORATORIES, INC.

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-20 (PZ-2)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-5-13

DRY AUGERED 0 TO 17 FT

WASH BORED _____ TO _____ FT

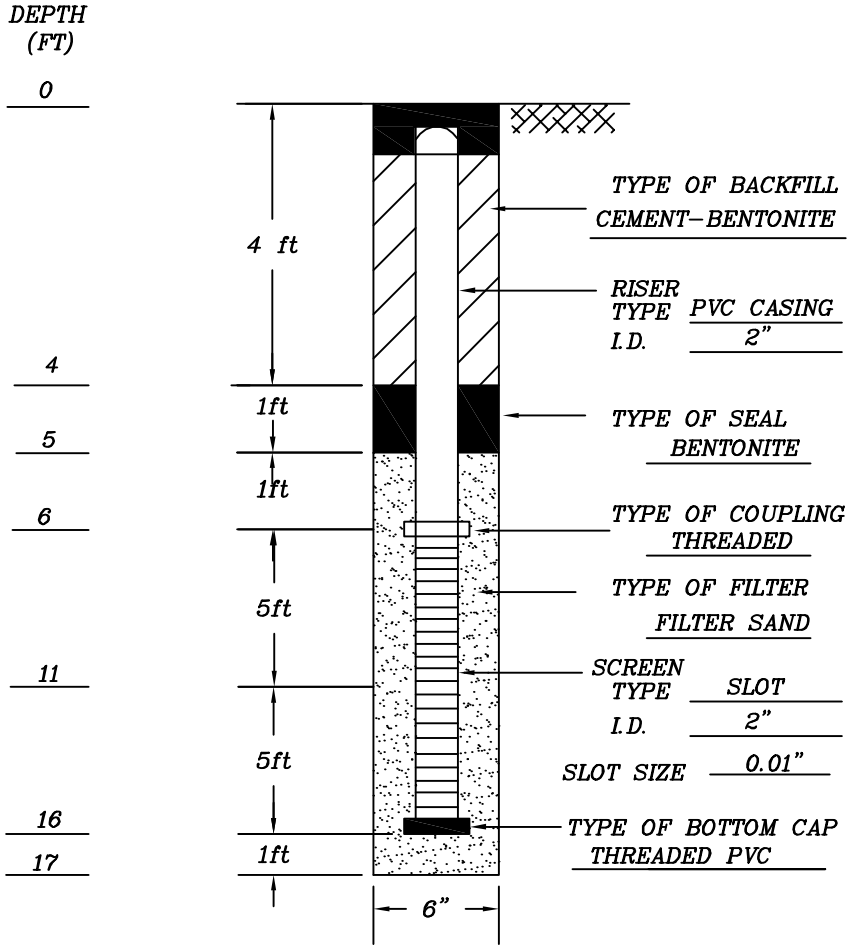
DRILING FLUID: _____

DEVELOPMENT DATE: 3-5-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-6-13	DRY
3-14-13	10.5'
4-10-13	10'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY;	STARTED:	ATL job No. G13-120
VAN & SON	3-5-13	
LOGGED BY: PV	COMPLETED: 3-5-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 2 OF 7

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-17 (PZ-3)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-5-13

DRY AUGERED 0 TO 20 FT

WASH BORED 20 TO 23 FT

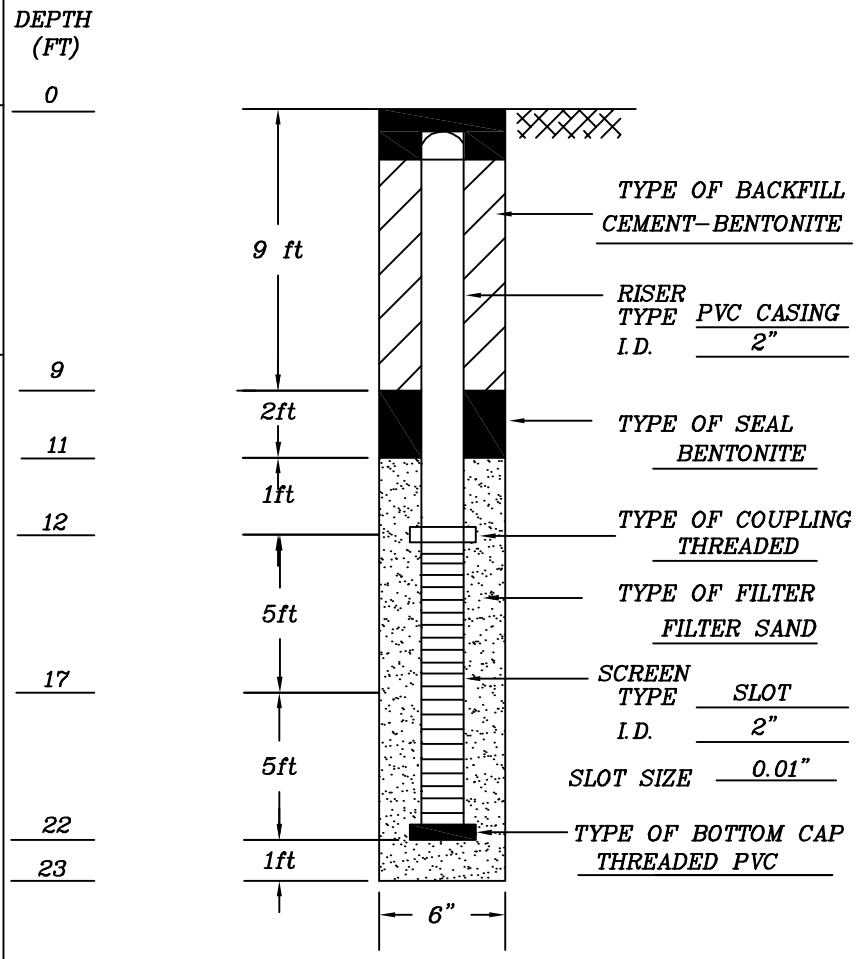
DRILING FLUID: _____

DEVELOPMENT DATE: 3-5-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-6-13	11'
3-14-13	10'
4-10-13	9.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY:	STARTED:	ATL job No. G13-120
VAN & SON	3-5-13	
LOGGED BY: PV	COMPLETED: 3-5-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 3 OF 7

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-22 (PZ-4)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-1-13

DRY AUGERED 0 TO 40 FT

WASH BORED _____ TO _____ FT

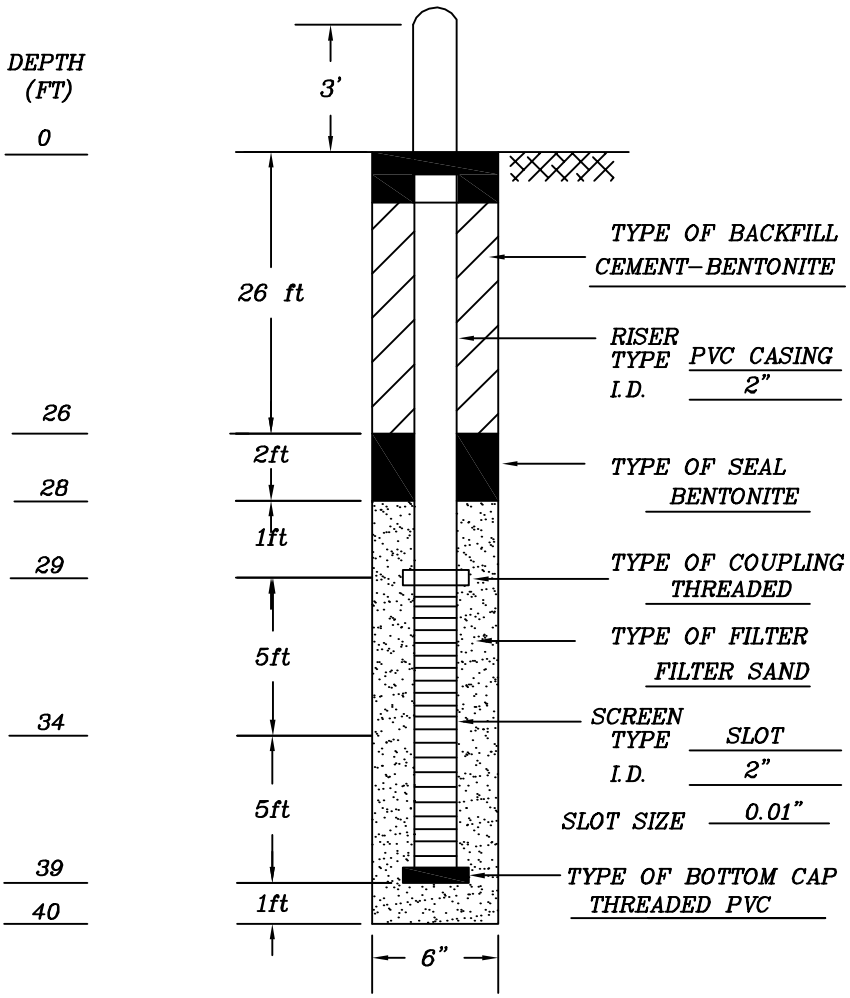
DRILING FLUID: _____

DEVELOPMENT DATE: 3-1-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-2-13	23'
3-14-13	22'
4-10-13	22.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY:	STARTED:	ATL job No. G13-120
VAN & SON	3-1-13	
LOGGED BY: PV	COMPLETED: 3-1-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 4 OF 7

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-42 (PZ-5)

GEOTECHNICAL CONSULTANT ASSOCIATED TESTING LABORATORIES, INC.	DESIGN CONSULTANT Cobbfendley & Associates, Inc.	CITY OF HOUSTON

COMPLETION DATE: 3-6-13

DRY AUGERED 0 TO 17 FT

WASH BORED _____ TO _____ FT

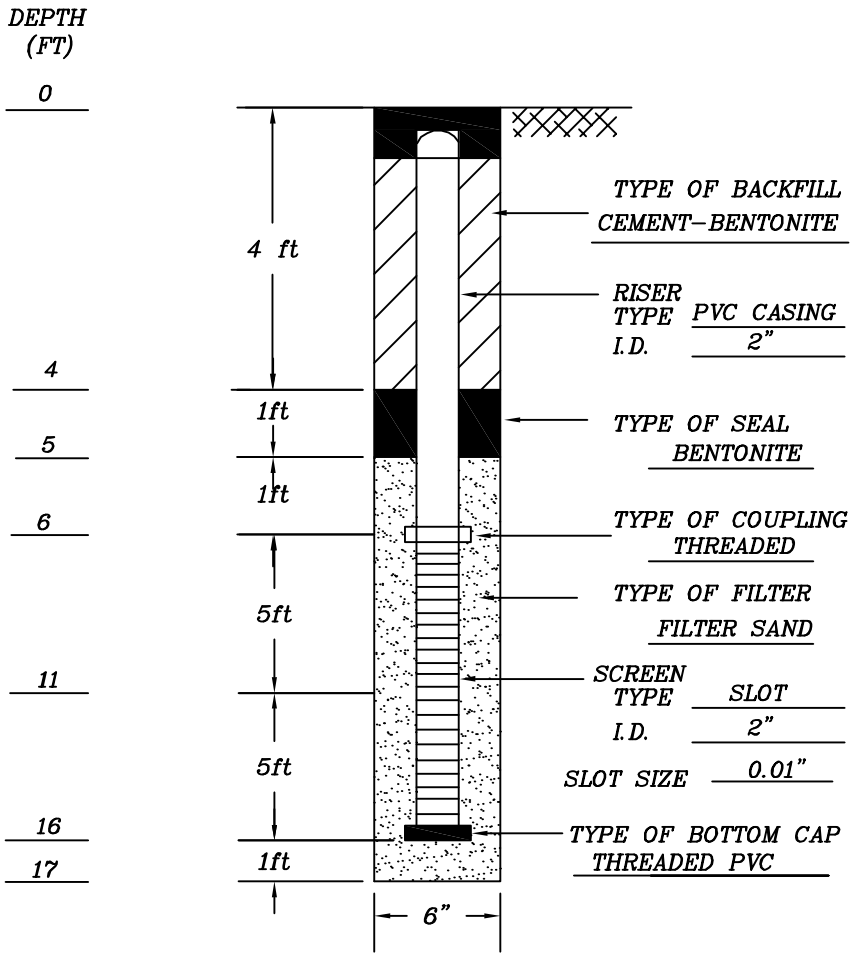
DRILING FLUID: _____

DEVELOPMENT DATE: 3-6-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-7-13	DRY
3-14-13	5.5'
4-10-13	4.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY: VAN & SON	STARTED: 3-6-13	ATL job No. G13-120
LOGGED BY: PV	COMPLETED: 3-6-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 5 OF 7

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-51 (PZ-6)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-6-13

DRY AUGERED 0 TO 18 FT

WASH BORED _____ TO _____ FT

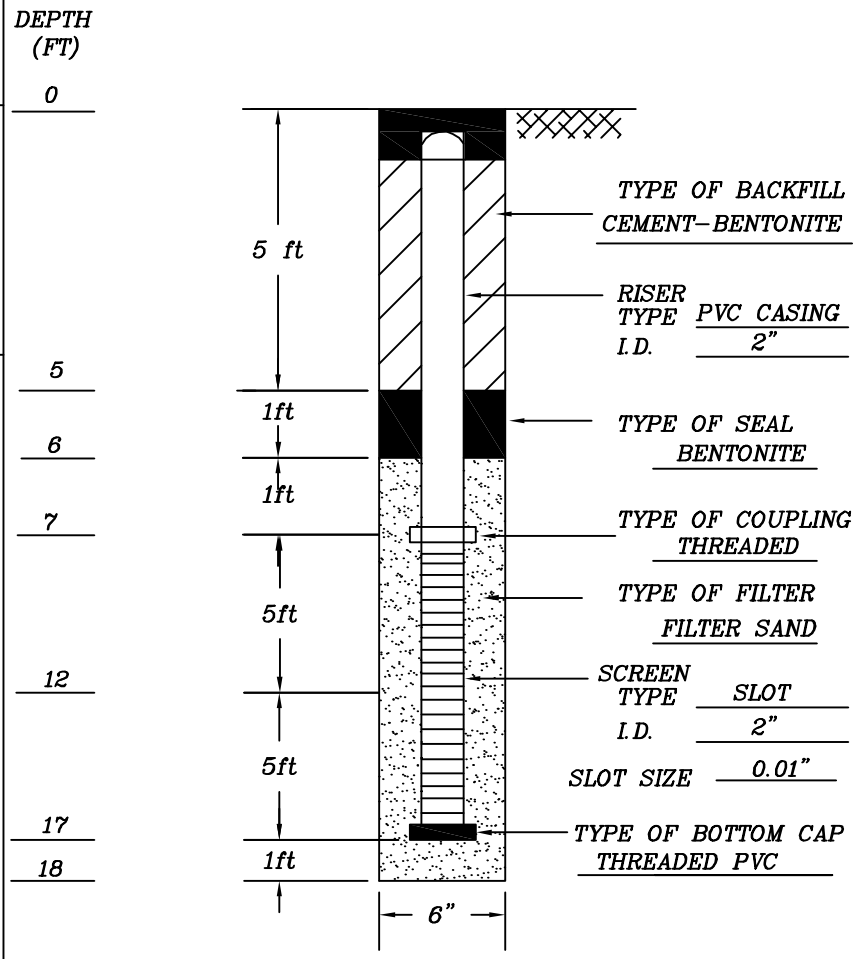
DRILING FLUID: _____

DEVELOPMENT DATE: 3-6-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-7-13	DRY
3-14-13	10'
4-10-13	9'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY:	STARTED:	ATL job No. G13-120
VAN & SON	3-6-13	
LOGGED BY: PV	COMPLETED: 3-6-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 6 OF 7

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP NORTH AREA WBS No.: S-000035-0182-3	PIEZOMETER NO.: B-66 (PZ-7)

GEOTECHNICAL CONSULTANT	DESIGN CONSULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	Cobbfendley & Associates, Inc.	

COMPLETION DATE: 3-6-13

DRY AUGERED 0 TO 17 FT

WASH BORED _____ TO _____ FT

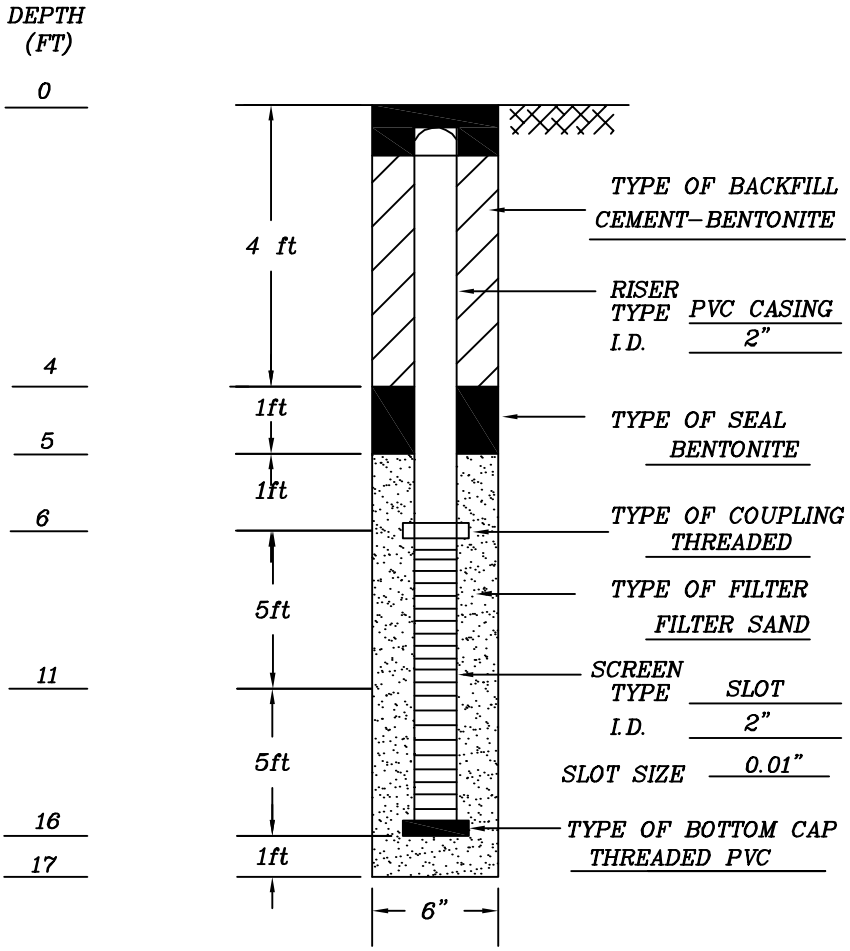
DRILING FLUID: _____

DEVELOPMENT DATE: 3-6-13

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
3-7-13	DRY
3-14-13	6'
4-10-13	5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY:	STARTED:	ATL job No. G13-120
VAN & SON	3-6-13	
LOGGED BY: PV	COMPLETED: 3-6-13	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 7 OF 7

G13-120

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Eastman St at Sylvester Rd (pz-1)	Houston	Tx	77009

Lat. ° ' " Long. ° ' " Grid # 65-13-6

3) Type of Work
☒ New Well ☐ Reconditioning
☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/5/2013
Completed 3/5/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
	Surface	
4	0	17

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary
☐ Bored ☐ Air Hammer ☐ Cable Tool
☐ Jetted ☐ Hollow Stem Auger
☐ Reverse Circulation
☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	17	Cl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall
☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	10	
2	n	Sch 40 PVC Screen	10	17	.010

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 6 ft. #sacks & material 1 cement
from 6 ft. to 8 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed
☐ Pitless Adapter Used ☐ Alternative Procedure Used

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow gpm

12) Packers

Type	Depth	Type	Depth
20/40	8-17		

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ____ ft. drawdown after ____ hrs.

16) Water Quality
Type of water: ____ Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☐ Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Albert City Houston State Tx Zip 77076

Signature	3/13/2013	Signature	/ /
Licensed Driller/Pump Installer	Date	Apprentice	Date

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner **within 60 days** upon completion of the well.

WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Delaney at Fulton St (pz-2)	Houston	Tx	77009

Lat. ° ' " Long. ° ' " Grid # 65-13-7

3) Type of Work
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/5/2013
Completed 3/5/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
4	Surface 0	17

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Hollow Stem Auger ☐ Reverse Circulation ☒ Other **dry auger**

From (ft)	To (ft)	Description and color of formation material
0	4	Sa
4	10	SaCl
10	17	Sa

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	10	
2	n	Sch 40 PVC Screen	10	17	.010

9) Annular Seal Data: i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 6 ft. #sacks & material 1 cement
from 6 ft. to 8 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow ____ gpm

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ____ ft. drawdown after ____ hrs.

12) Packers

Type	Depth	Type	Depth
20/40	8-17		

16) Water Quality
Type of water: ____ Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☐ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature Licensed Driller/Pump Installer	Date	Signature Apprentice	Date
	3/13/2013		/ /

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
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Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner **within 60 days** upon completion of the well.

WELL REPORT

1) OWNER — A. WELL IDENTIFICATION AND LOCATION DATA

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Robert E Lee at Karcher St (pz-3)	Houston	Tx	77009

Lat. ° ' " Long. ° ' " Grid # 65-13-7

3) Type of Work
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/5/2013
Completed 3/5/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
	Surface	
4	0	23

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Hollow Stem Auger ☐ Reverse Circulation ☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	10	Cl
10	15	ClSa
15	20	Sa
20	23	Cl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	13	
2	n	Sch 40 PVC Screen	13	23	.010

9) Annular Seal Data: i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 9 ft. #sacks & material 1 cement
from 9 ft. to 11 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow gpm

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ft. drawdown after hrs.

12) Packers

Type	Depth	Type	Depth
20/40	11-23		

16) Water Quality
Type of water: Depth of Strata: Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ☐ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe)

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature	Date	Signature	Date
Licensed Driller/Pump Installer	3/13/2013	Apprentice	/ /

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Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

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WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Link Rd @ White Oak Bayou (pz-4)	Houston	Tx	77009

Lat. ° ' " Long. ° ' " Grid # 65-13-6

3) Type of Work
☒ New Well ☐ Reconditioning
☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/1/2013
Completed 3/1/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
	Surface	
4	0	70

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary
☐ Bored ☐ Air Hammer ☐ Cable Tool
☐ Jetted ☐ Hollow Stem Auger
☐ Reverse Circulation
☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	20	Cl
20	30	SaCl
30	70	Cl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall
☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	20	
2	n	Sch 40 PVC Screen	20	40	.010

9) Annular Seal Data: i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 16 ft. #sacks & material 1.5 cement
from 16 ft. to 18 ft. #sacks & material .5 bentonite
from 40 ft. to 70 ft. #sacks & material 2 cement
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed
☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow ____ gpm

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ____ ft. drawdown after ____ hrs.

12) Packers

Type	Depth	Type	Depth
20/40	18-40		
seismic plug	set at 40'		

16) Water Quality
Type of water: ____ Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☐ Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature	Date	Signature	Date
Licensed Driller/Pump Installer	3/13/2013	Apprentice	/ /

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Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

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WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Aurora St at Columbia (pz-5)	Houston	Tx	77008

Lat. ° ' " Long. ° ' " Grid # 65-13-6

3) Type of Work
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/6/2013
Completed 3/6/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
4	Surface 0	17

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Hollow Stem Auger ☐ Reverse Circulation ☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	15	Cl
15	17	SaCl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	10	
2	n	Sch 40 PVC Screen	10	17	.010

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 6 ft. #sacks & material 1.5 cement
from 6 ft. to 8 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow gpm

12) Packers

Type	Depth	Type	Depth
20/40	8-17		

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ____ ft. drawdown after ____ hrs.

16) Water Quality
Type of water: ____ Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☐ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature	Date	Signature	Date
Licensed Driller/Pump Installer	3/13/2013	Apprentice	/ /

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	E. 20th at Harvard (pz-6)	Houston	Tx	77008

Lat. ° ' " Long. ° ' " Grid # 65-13-6

3) Type of Work
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock or Livestock
If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/6/2013
Completed 3/6/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
4	Surface 0	18

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Hollow Stem Auger ☐ Reverse Circulation ☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	10	Cl
10	12	SaCl
12	18	Cl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	10	
2	n	Sch 40 PVC Screen	10	18	.010

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 6 ft. #sacks & material 1.5 cement
from 6 ft. to 8 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

11) Water Level
Static level dry ft. Date 3/5/2013
Artesian Flow gpm

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ft. drawdown after hrs.

12) Packers

Type	Depth	Type	Depth
20/40	8-18		

16) Water Quality
Type of water: Depth of Strata: Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ☐ Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe)

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature Licensed Driller/Pump Installer	Date	Signature Apprentice	Date
	3/13/2013		/ /

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner **within 60 days** upon completion of the well.

WELL REPORT

1) OWNER — **A. WELL IDENTIFICATION AND LOCATION DATA**

Name	Address	City	State	Zip
City of Houston Geptech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Arlington at E. 14th St (pz-7)	Houston	Tx	77008

Lat. ° ' " Long. ° ' " Grid # 65-13-6

3) Type of Work
☒ New Well ☐ Reconditioning
☐ Replacement ☐ Deepening

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
☐ Rig Supply ☐ Stock or Livestock If Public Supply, were plans approved? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 3/6/2013
Completed 3/6/2013

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
4	Surface 0	17

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary
☐ Bored ☐ Air Hammer ☐ Cable Tool
☐ Jetted ☐ Hollow Stem Auger
☐ Reverse Circulation
☒ Other dry auger

From (ft)	To (ft)	Description and color of formation material
0	6	Cl
6	8	SaCl
8	12	Cl
12	14	SaCl
14	17	Cl

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall
☐ Under-reamed ☐ Gravel Packed ☒ Other 9&12
Gravel Packed interval from ft. to ft. Size:

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft) From	Setting (ft) To	Gage Casing Screen
2	n	Sch 40 PVC Riser	0	10	
2	n	Sch 40 PVC Screen	10	17	.010

9) Annular Seal Data: i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 6 ft. #sacks & material 1.5 cement
from 6 ft. to 8 ft. #sacks & material .5 bentonite
from ft. to ft. #sacks & material
Method Used tremie
Distance to septic field or other concentrated contamination na ft.
Distance to Property Line na ft Method na
Verified: na

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: na Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Material used & # Sacks

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed
☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other na
Depth to pump bowls, cylinder, jet, etc., ft.

11) Water Level
Static level dry ft. Date 3/6/2013
Artesian Flow gpm

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: na gpm with ft. drawdown after hrs.

12) Packers

Type	Depth	Type	Depth
20/40	8-17		

16) Water Quality
Type of water: Depth of Strata: Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☐ Yes ☒ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ☐ Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe)

☐ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 3003M
Address 319 John Alber City Houston State Tx Zip 77076

Signature	Date	Signature	Date
Licensed Driller/Pump Installer	3/13/2013	Apprentice	/ /

Form provided by Forms On-A-Disk - (214) 340-9429 - FormsOnADisk.com

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Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Eastman St at Sylvester Rd	Houston	Tx	77009

3) Owner's Well No. 1 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-6

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller: Edward VanAntwerp | License No. 3003M

7) Drilled 03/05/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 17 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging: Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	17

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	17	1.5

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print): Van and Sons Drilling Service, Inc

Address 319 John Alber | City Houston | State Tx | Zip 77076

Signature		Signature	
Licensed Driller/Pump Installer	5/23/2013 Date	Apprentice	/ / Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Delaney at Fulton	Houston	Tx	77009

3) Owner's Well No. 2 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-7

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller: Edward VanAntwerp | License No. 3003M

7) Drilled 03/05/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 17 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging: Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	17

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	17	1.5

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print): Van and Sons Drilling Service, Inc

Address 319 John Alber | City Houston | State Tx | Zip 77076

Signature		Signature	
Licensed Driller/Pump Installer	5/23/2013 Date	Apprentice	/ / Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Robert E Lee at Karcher	Houston	Tx	77009

3) Owner's Well No. 3 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-7

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller: Edward VanAntwerp | License No. 3003M

7) Drilled 03/05/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 23 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging: Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	23

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	23	2

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print): Van and Sons Drilling Service, Inc

Address: 319 John Alber | City: Houston | State: Tx | Zip: 77076

Signature	5/23/2013	Signature	/ /
Licensed Driller/Pump Installer	Date	Apprentice	Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Link Rd at White Oak Bayou	Houston	Tx	77009

3) Owner's Well No. 4 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-6

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller: Edward VanAntwerp | License No. 3003M

7) Drilled 03/01/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 40 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging: Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	40

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	40	3

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print): Van and Sons Drilling Service, Inc

Address: 319 John Alber | City: Houston | State: Tx | Zip: 77076

Signature		Signature	
Licensed Driller/Pump Installer	5/23/2013 Date	Apprentice	/ / Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Aurora St at Columbia	Houston	Tx	77008

3) Owner's Well No. 5 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-6

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller	License No.
Edward VanAntwerp	3003M

7) Drilled 03/06/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 17 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging
Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	17

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	17	1.5

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc

Address 319 John Alber | City Houston | State Tx | Zip 77076

Signature		Signature	
Licensed Driller/Pump Installer	5/23/2013 Date	Apprentice	/ / Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	E. 20th at Harvard	Houston	Tx	77009

3) Owner's Well No. 6 | Long. ° ' " | Lat. ° ' " | Grid # 65-13-6

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller: Edward VanAntwerp | License No. 3003M

7) Drilled 03/06/2013 | 8) Diameter of hole 4 inches | 9) Total depth of well 18 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging: Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	18

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	18	1.5

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print): Van and Sons Drilling Service, Inc

Address 319 John Alber | City Houston | State Tx | Zip 77076

Signature	5/23/2013	Signature	/ /
Licensed Driller/Pump Installer	Date	Apprentice	Date

Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

PLUGGING REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
City of Houston Geotech Dept	611 Walker Floor 14	Houston	Tx	77002

2) WELL LOCATION

County	Physical Address	City	State	Zip
Harris	Arlington at E. 14th St	Houston	Tx	77008

3) Owner's Well No. 7	Long. ° ' "	Lat. ° ' "	Grid # 65-13-6

4) Type of Well ☐ Water ☒ Monitor ☐ Injection ☐ De-Watering

5) N↑

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller	License No.
Edward VanAntwerp	3003M

7) Drilled 03/06/2013	8) Diameter of hole 4 inches	9) Total depth of well 17 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 05/22/2013

12) Name of Driller/Pump Installer or Well Owner performing the plugging
Edward VanAntwerp

License No. 3003M

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

CASING LEFT IN WELL

DIAMETER (inches)	FROM (feet)	TO (feet)
2	0	17

CEMENT/BENTONITE PLUG(S) PLACED IN WELL

FROM (feet)	TO (feet)	SACKS
0	17	1.5

11) REMOVE ALL REMOVEABLE CASING

Please check box beside the method of plugging used

- ☒ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.
- ☐ Large diameter well filled with clay material from top to bottom.

COMMENTS

tried to pull well material
grouted well material in place

D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or Individual's Name (type or print)	Van and Sons Drilling Service, Inc		
Address 319 John Alber	City Houston	State Tx	Zip 77076

Signature	5/23/2013	Signature	/ /
Licensed Driller/Pump Installer	Date	Apprentice	Date

Type or print on this form a list of wells for which you are submitting "Well Report" forms.

State of Texas

State Well Report Submission Form

Send original copy, along with original copies of your State Well Reports, by certified mail to:
TDLR
P.O. Box 12157
Austin, Texas 78711

DATE DRILLED	WELL OWNER	COUNTY
pz-1 03/05/2013	City of Houston Geotechnical Dept	Harris
pz-2 03/05/2013	611 Walker, Floor 14	
pz-3 03/05/2013	Houston, Tx 77002	
pz-4 03/01/2013		
pz-5 03/06/2013		
pz-6 03/06/2013		
pz-7 03/06/2013		
pz1-7 plugged 5/22/2013		

Edward Van Antwerp
LICENSED DRILLER/PUMP INSTALLER
(Please type or print)

3003M
LICENSE NUMBER

03/13/2013
DATE

TDLR FORM WWD002 12-15-2000

ORIGINAL - TDLR COPY - DRILLER/PUMP INSTALLER

Form provided by Forms On-A-Disk - (214) 340-9429 - FormsOnADisk.com

APPENDIX 3

BORING LOGS AND KEY TO LOG TERMS AND SYMBOLS

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-1

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

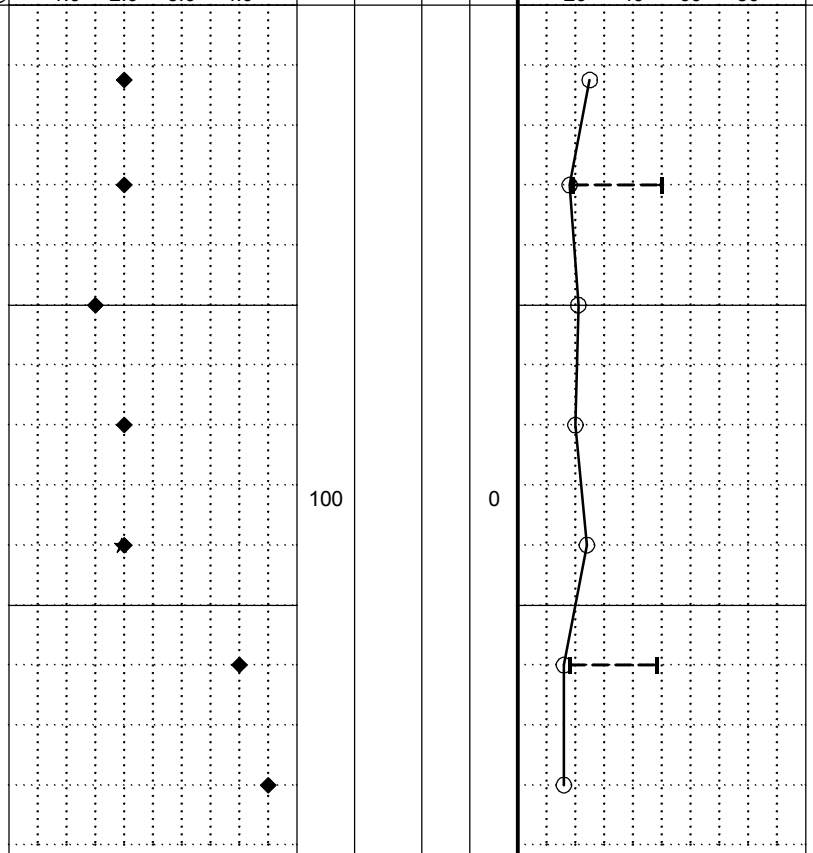
DATE 3/5/2013

SURFACE ELEVATION 53.93

LOCATION

Eastman St.
Northing: 13862485.36
Easting: 3116290.33

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				4" Crushed stone gravel												
				Fat Clay (CH), stiff, high plasticity, dark gray	2.0						25					
				..with ferrous nodules below 2'	2.0						18	50	19	31	86	
					1.5						21					
5		CH														
				..with calcareous nodules below 6'	2.0						20					
					2.0		100			0	24					
10				Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	4.0						16	48	18	30		
		CL		..hard below 12'	4.5						16					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-2

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/5/2013

SURFACE ELEVATION 55.36

LOCATION

E.28th St.
Northing: 13862127.39
Easting: 3115942.36

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)
0		2.5" Asphalt										
		3.75" Crushed shell										
		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.0					23	51	19	32	78
		..with calcareous nodules below 2'	2.5					22				
		..with ferrous nodules below 4'	3.0					21				
5	CH		2.5					20				
			3.75					23	57	20	37	
10			4.0	120			0	17				
			3.25					17				

Legend: ● N (blows/ft) 20 40 60 80; ▲ UU (tsf) 1.0 2.0 3.0 4.0; ★ DD (pcf) 90 100 110 120; ◆ P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; 20 40 60 80

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-3 (PZ-1)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

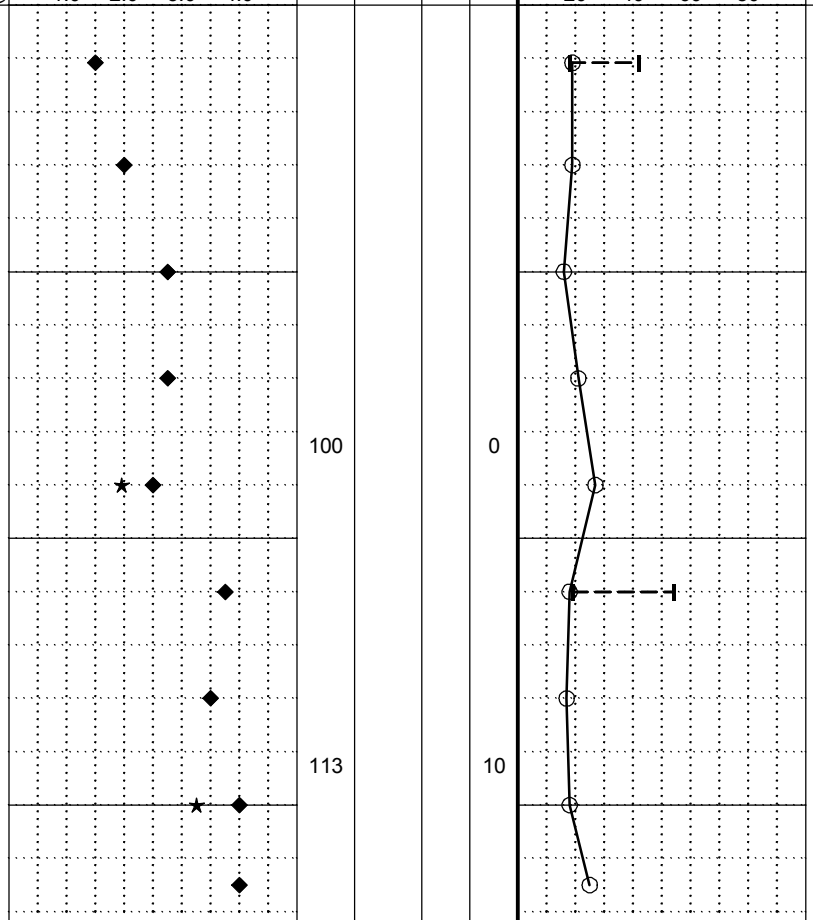
DATE: 3/6/2013

SURFACE ELEVATION: 55.09

LOCATION

Eastman St.
Northing: 13861820.48
Easting: 3116325.5

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	DRY DENSITY (pcf)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)
0		2" Asphalt	1.5			19	42	18	24	79
		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan								
		..with sand seam below 2'	2.0			19				
	CL	..very stiff with calcareous nodules below 4'	2.75			16				
5			2.75			21				
		Fat Clay with Sand (CH), stiff, high plasticity, reddish brown	2.5	100	0	27				
10		..very stiff, light gray and tan below 10'	3.75			18	54	19	35	
	CH		3.5			17				
			4.0	113	10	18				
15			4.0			25				



ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: Dry, 7 days Water Level: 13', 30 days Water Level: 8'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17'; PZ water level: Dry (3/06/2013); PZ water level: 13' (3/14/2013); PZ water level: 8' (4/10/2013) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-4

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

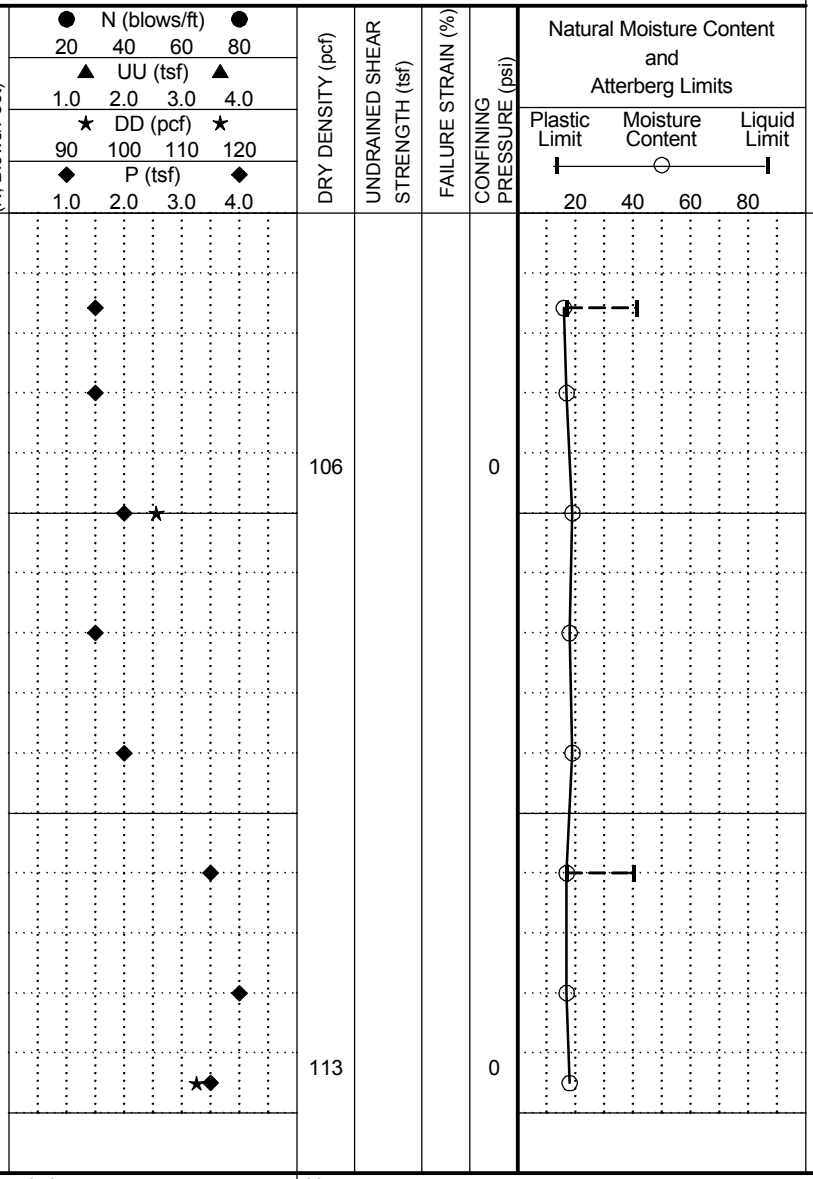
DATE: 3/26/2013

SURFACE ELEVATION: 54.00

LOCATION

Angeline St.
Northing: 13861806.34
Easting: 3117333.03

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				10" Shell												
		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan (Fill 9 feet) ..with calcareous nodules below 2'	1.5						16	41	17	24	72	
					1.5						17					
					2.0		106			0	19					
5					1.5						18					
					2.0						19					
10		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan ..very stiff with ferrous nodules below 10'	3.5						17	40	17	23		
					4.0						17					
					3.5		113			0	18					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-5

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

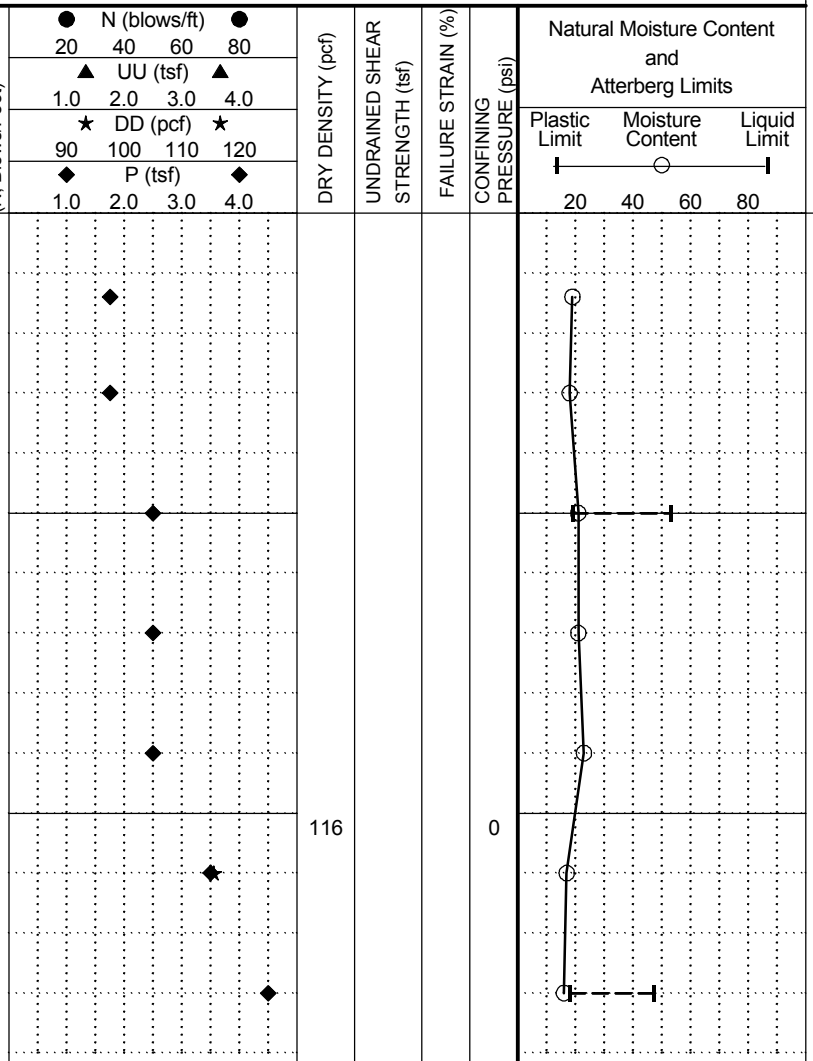
DATE 3/5/2013

SURFACE ELEVATION 53.60

LOCATION

Samuel St.
Northing: 13861444.87
Easting: 3117144.04

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2.5" Asphalt												
				7" Crushed shell												
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.75						19					
				..with ferrous nodules below 2'	1.75						18					
				..very stiff with calcareous nodules below 4'	2.5						21	53	19	34	78	
5		CH			2.5						21					
					2.5						23					
10				Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	3.5		116			0	17					
		CL		..hard with ferrous nodules below 12'	4.5						16	47	18	29		



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-6

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

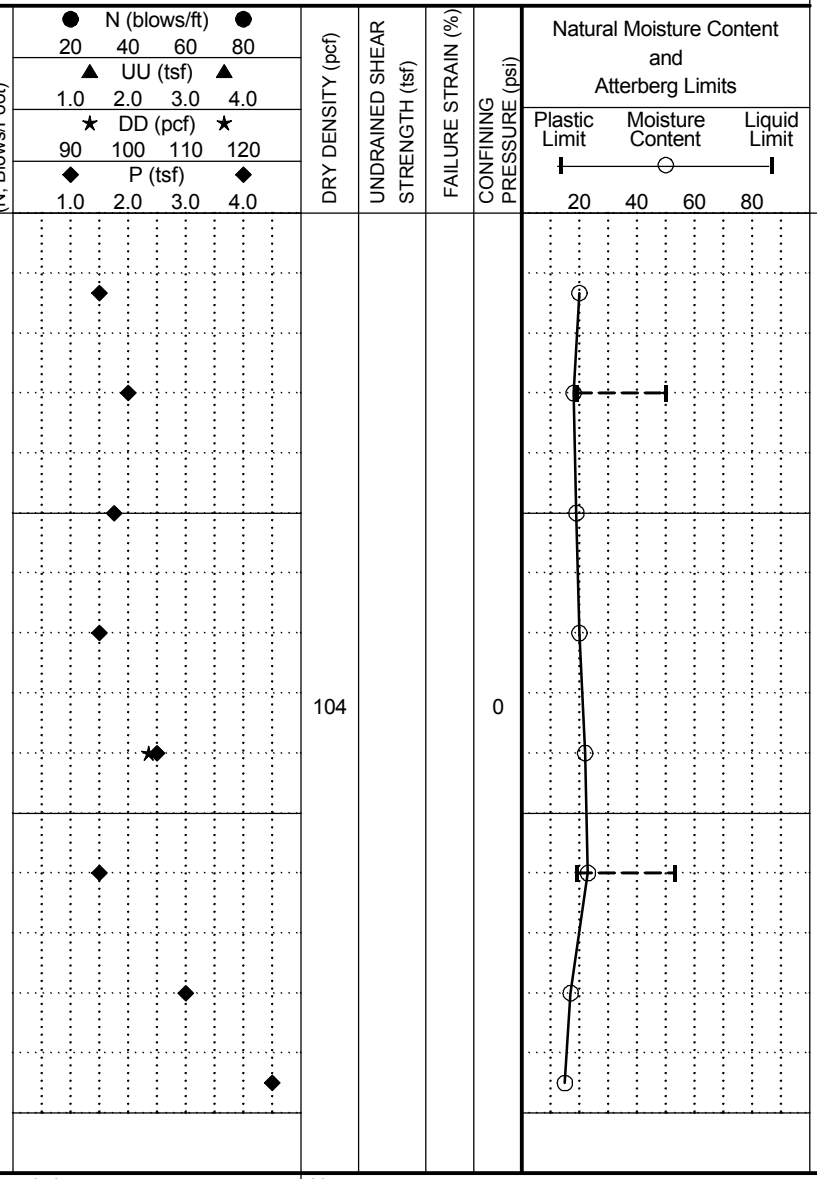
DATE: 3/5/2013

SURFACE ELEVATION: 55.72

LOCATION

Service St.
Northing: 13861108.29
Easting: 3116028.07

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				3" Crushed gravel												
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.5						20					
				..with calcareous nodules below 2'	2.0						18	50	19	31	83	
				..with ferrous nodules below 4'	1.75						19					
5																
					1.5						20					
		CH			2.5		104			0	22					
10					1.5						23	53	19	34		
				..very stiff below 12'	3.0						17					
				..hard below 14'	4.5						15					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-7

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/5/2013

SURFACE ELEVATION 56.54

LOCATION

Eastman St.
Northing: 13860819
Easting: 3116348.12

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	N (blows/ft) 20 40 60 80 / UU (tsf) 1.0 2.0 3.0 4.0 / DD (pcf) 90 100 110 120 / P (tsf) 1.0 2.0 3.0 4.0	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt														
				6" Crushed stone														
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	1.5								17	31	16	15	80	
					1.5								15					
		CL		..with calcareous nodules below 4'	1.5								18					
5				..with ferrous nodules below 6'	2.0								17					
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0								20	56	20	36		
10		CH		..firm with calcareous nodules below 10'	1.5			97			0		29					
					1.0								19					

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-8

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/5/2013

SURFACE ELEVATION 55.55

LOCATION

Service St.
Northing: 13861069.85
Easting: 3116793.75

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				8" Crushed stone												
		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						18	42	18	24	83	
				..with ferrous nodules below 2'	1.5						19					
				..with calcareous nodules below 4'	1.5						18					
5																
					2.0						19					
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0						18	54	19	35		
10					2.5		119			0	16					
		CH		..very stiff below 12'	3.0						20					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-9

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

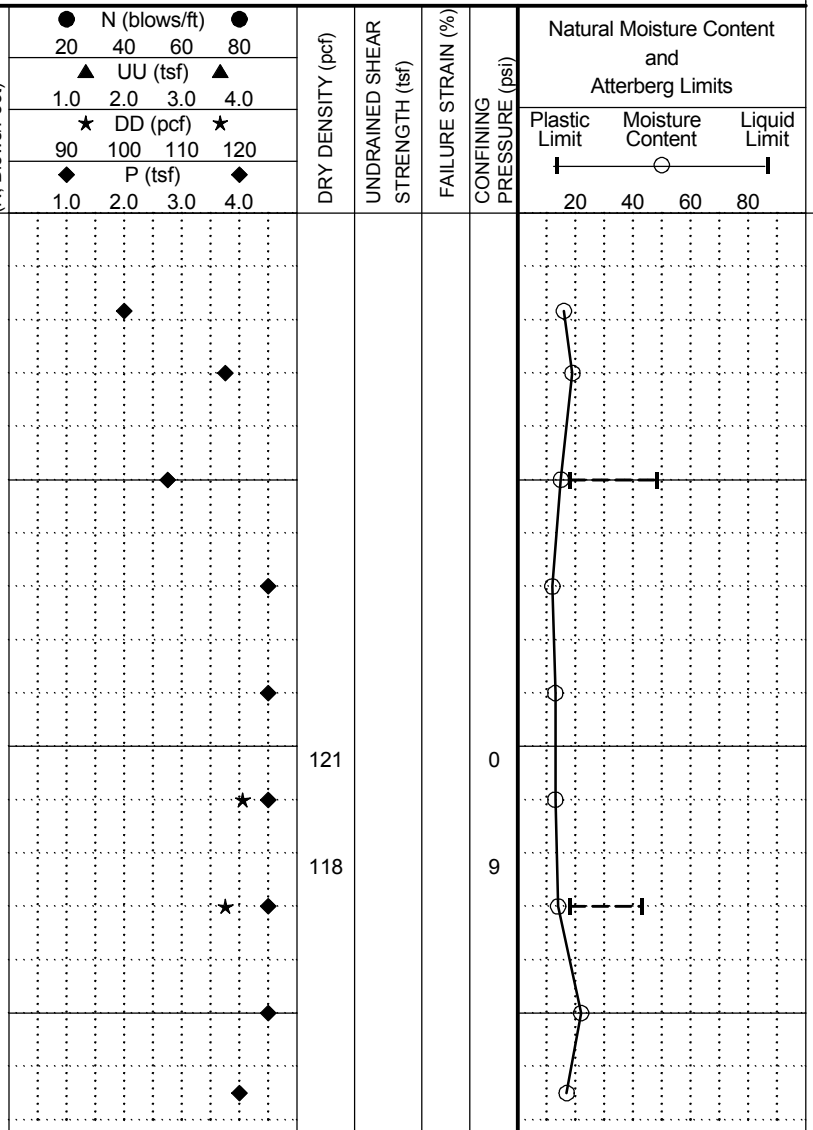
DATE 3/6/2013

SURFACE ELEVATION 51.21

LOCATION

Walton St.
Northing: 13862101.77
Easting: 3117793.96

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				20" Lime stabilized shell												
				Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						16					
				..very stiff below 2'	3.75						19					
				..with calcareous nodules below 4'	2.75						15	48	18	30	78	
5																
				..hard below 6'	4.5						12					
				..with ferrous nodules below 8'	4.5						13					
		CL														
10					4.5		121			0	13					
					4.5		118			9	14	43	18	25	85	
					4.5						22					
15																
				..very stiff below 16'	4.0						17					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-10

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/26/2013

SURFACE ELEVATION 52.79

LOCATION

Enid St.
Northing: 13861746.13
Easting: 3118142.8

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5.75" Concrete												
				7" Lime stabilized with shell												
				Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan ..stiff with calcareous nodules below 2'	3.0						15					
					2.0		117			0	13					
				..very stiff with ferrous nodules below 4'	3.25						11	33	16	17	75	
5																
					4.0						12					
		CL			3.5						21					
10					3.5						16					
				..hard below 12'	4.5		116			0	17					
					4.5						19					
15																
		CH		Fat Clay (CH), very stiff, high plasticity, light gray and tan with calcareous nodules	4.0						17	54	19	35	95	

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 18', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-11

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

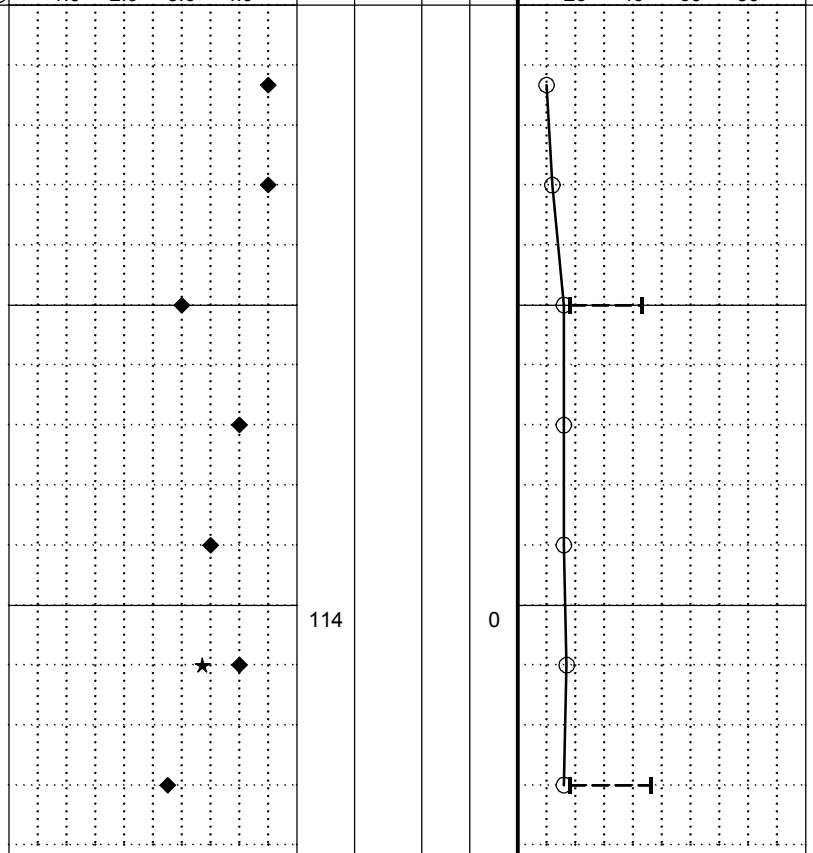
DATE 3/5/2013

SURFACE ELEVATION 52.61

LOCATION

Tabor St.
Northing: 13861310.78
Easting: 3117570.4

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				3" Crushed stone												
				Lean Clay with Sand (CL), hard, high plasticity, light gray and tan	4.5						10					
					4.5						12					
				..very stiff below 4'	3.0						16	43	18	25	73	
5																
				..with ferrous nodules below 6'	4.0						16					
		CL			3.5						16					
10					4.0		114			0	17					
					2.75						16	46	18	28		



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-12

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

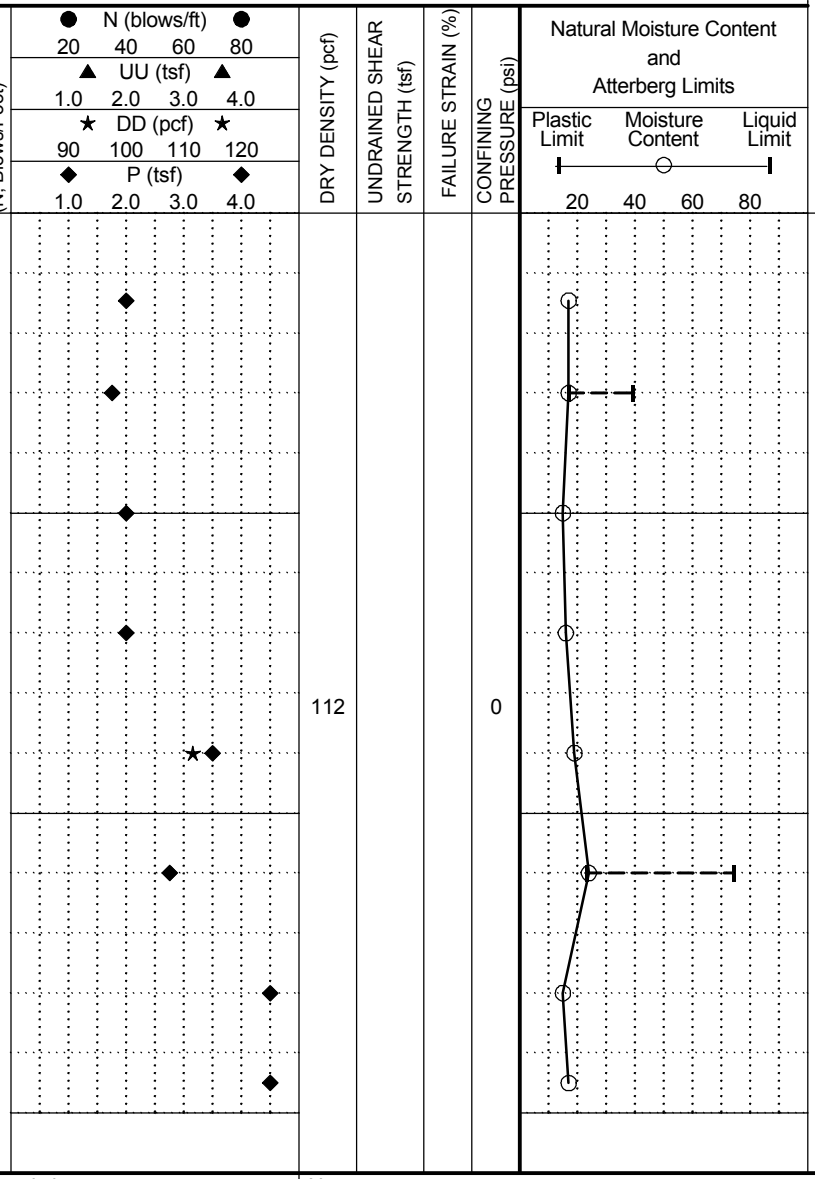
DATE 3/5/2013

SURFACE ELEVATION 52.76

LOCATION

Enid St.
Northing: 13861208.96
Easting: 3118170.57

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				8" Crushed gravel base												
		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						17					
				..with calcareous nodules below 2'	1.75						17	39	17	22	79	
				..with ferrous nodules below 4'	2.0						15					
5					2.0						16					
				..very stiff below 8'	3.5		112			0	19					
10		CH		Fat Clay with Sand (CH), very stiff, very high plasticity, light gray and tan	2.75						24	74	23	51		
				..hard with ferrous nodules below 12'	4.5						15					
					4.5						17					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-13

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

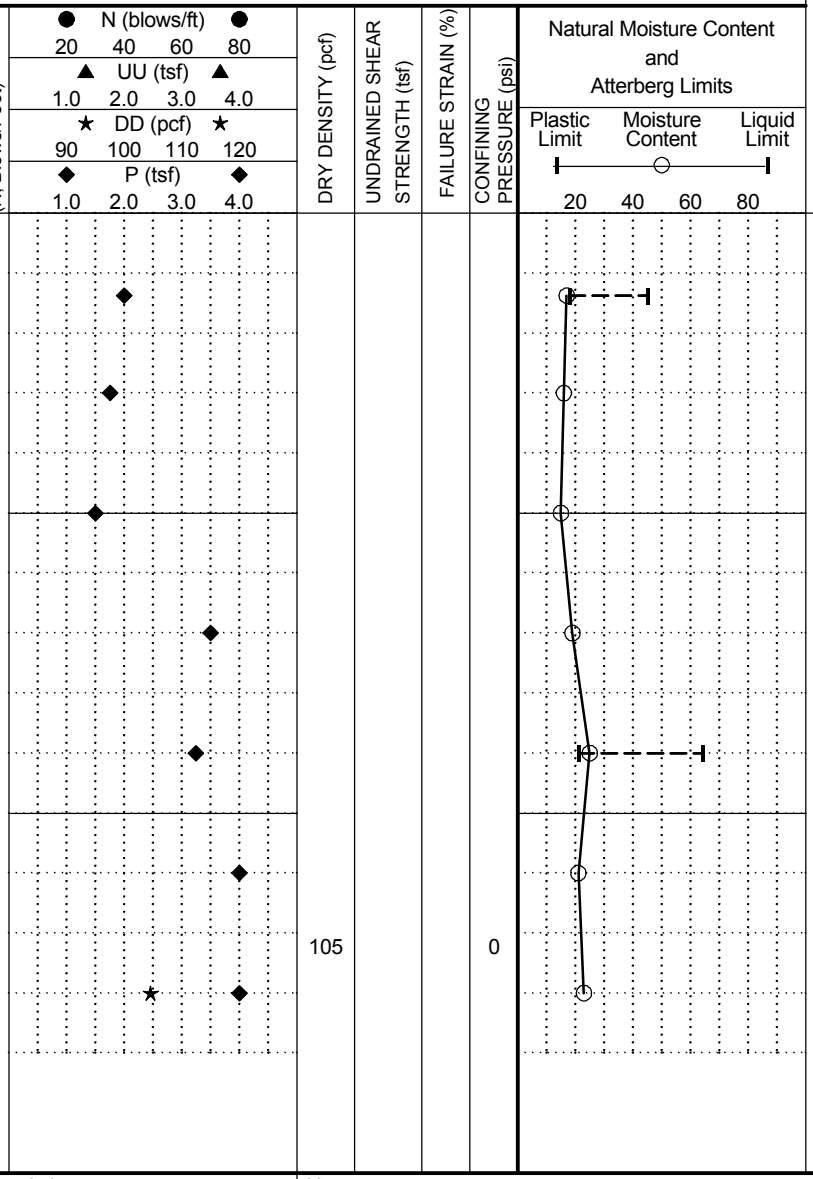
DATE: 3/5/2013

SURFACE ELEVATION: 54.48

LOCATION

Eichwurzel Ln.
Northing: 13861455.69
Easting: 3118757.65

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				7" Crushed gravel												
		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						17	45	18	27	76	
				..with ferrous nodules below 2'	1.75						16					
				..with calcareous nodules below 4'	1.5						15					
5				..very stiff below 6'	3.5						19					
		CH		Fat Clay with Sand (CH), very stiff, very high plasticity, light gray and tan with calcareous and ferrous nodules	3.25						25	64	21	43		
10					4.0						21					
					4.0		105			0	23					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-14

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

SURFACE ELEVATION: 55.82

LOCATION

Eichwurzel Ln.
Northing: 13861490.04
Easting: 3119215.96

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				5" Crushed gravel base												
				Fat Clay with Sand (CH), firm, high plasticity, light gray and tan ..stiff with ferrous nodules below 2'	1.0						21					
					1.5						19	56	20	36	72	
				..with calcareous nodules below 4'	2.0						20					
5																
					2.0						19					
		CH			1.5						25					
10					1.5						24	56	20	36		
				..firm below 12'	1.5		108			0	18					
					1.0						18					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 14', After Drilling Water Level: 13'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-15

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

SURFACE ELEVATION: 56.55

LOCATION

Eichwurzel Ln.
Northing: 13861514.07
Easting: 3119810.5

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				7" Crushed limestone base												
		SM		Silty Sand (SM), non plastic, light gray and tan							15					
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5						13	32	16	16	52	
				..with calcareous nodules below 4'	4.5						13					
5																
					4.5						13					
		CL														
				..very stiff, high plasticity below 8'	4.0						16	40	17	23		
10				..firm, reddish brown below 10'	1.0		97			0	28					

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-16

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

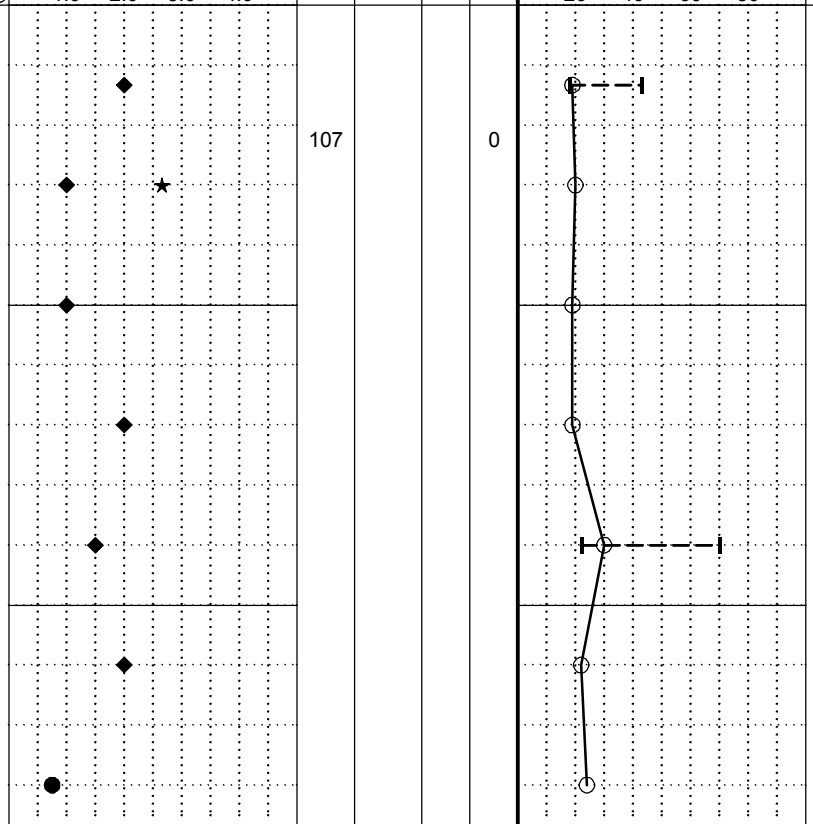
DATE 3/8/2013

SURFACE ELEVATION 53.96

LOCATION

Robert Lee Rd.
Northing: 13861069.14
Easting: 3118871.02

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				4" Crushed gravel												
				Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						19	43	18	25	81	
				..firm with ferrous nodules below 2'	1.0		107			0	20					
		CL		..with calcareous nodules below 4'	1.0						19					
5				..stiff below 6'	2.0						19					
				Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan with calcareous nodules	1.5						30	70	22	48		
10		CH			2.0						22					
		SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		15					24					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13.5', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-17 (PZ-3)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/5/2013

SURFACE ELEVATION: 54.77

LOCATION

Robert Lee Rd.
Northing: 13861093.49
Easting: 3119440.33

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				4" Lime stabilized shell												
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.5						19	50	19	31	72	
				..very stiff with calcareous nodules below 2'	4.0						17					
				..with ferrous nodules below 4'	2.5						23					
5																
					2.75						26					
		CH														
				..stiff below 8'	2.5		95			0	29					
10																
					2.0						29					
					1.5		87			9	38					
				Silty Sand (SM), loose, non plastic, light gray and tan		10					25					
15																
				..medium dense below 16'		15					24				46	
		SM														
						13					23					
20																
				Fat Clay (CH), hard, high plasticity, light gray and tan with ferrous nodules	4.5						22	50	19	31	92	
		CH														

Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (20, 40, 60, 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 11.5', After Drilling Water Level: 11', 24 hrs Water Level: 11', 7 days Water Level: 10', 30 days Water Level: 9.5'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 23'; Hole Caved at: 12'; PZ water level: 11' (3/06/2013); PZ water level: 10' (3/14/2013); PZ water level: 9.5' (4/10/2013) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-18

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

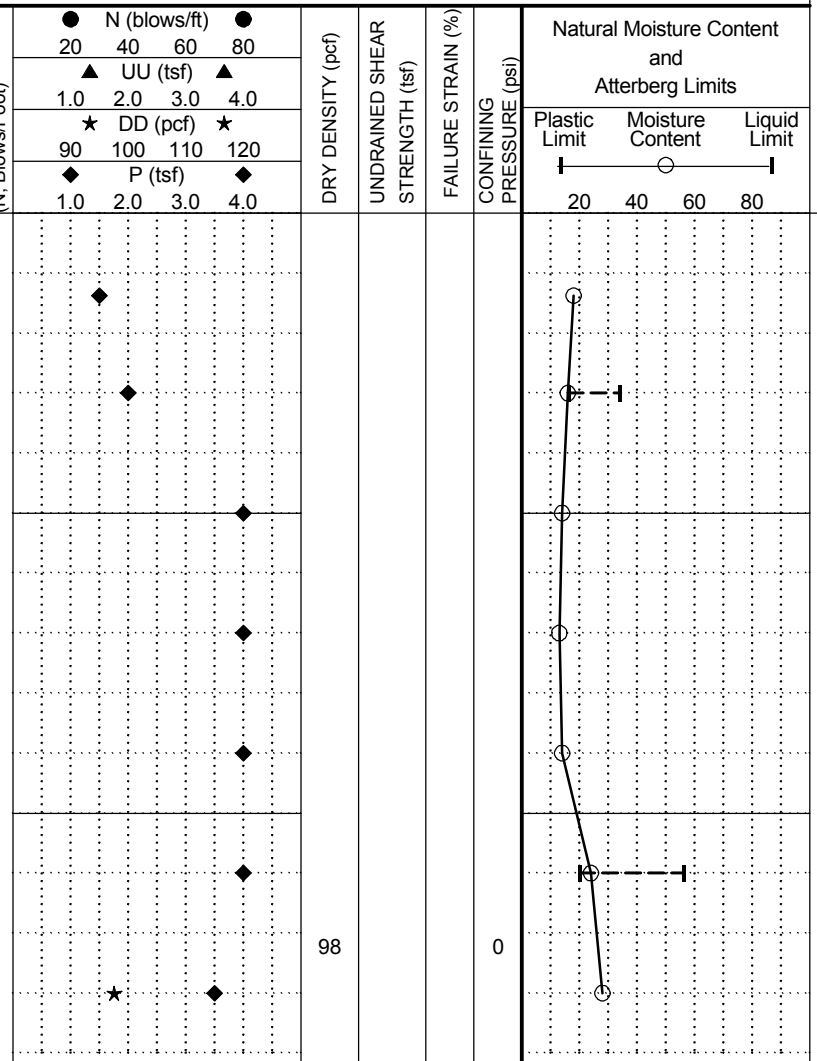
DATE 3/6/2013

SURFACE ELEVATION 57.57

LOCATION

Leon St.
Northing: 13862153.61
Easting: 3118950.09

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				5" Crushed gravel												
		CL		Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	1.5						18					
				..with ferrous nodules below 2'	2.0						16	34	16	18	76	
				..very stiff with calcareous nodules below 4'	4.0						14					
5					4.0						13					
					4.0						14					
10		CH		Fat Clay (CH), very stiff, high plasticity, reddish brown	4.0						24	56	20	36	98	
				..with ferrous nodules below 12'	3.5		98			0	28					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-19

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

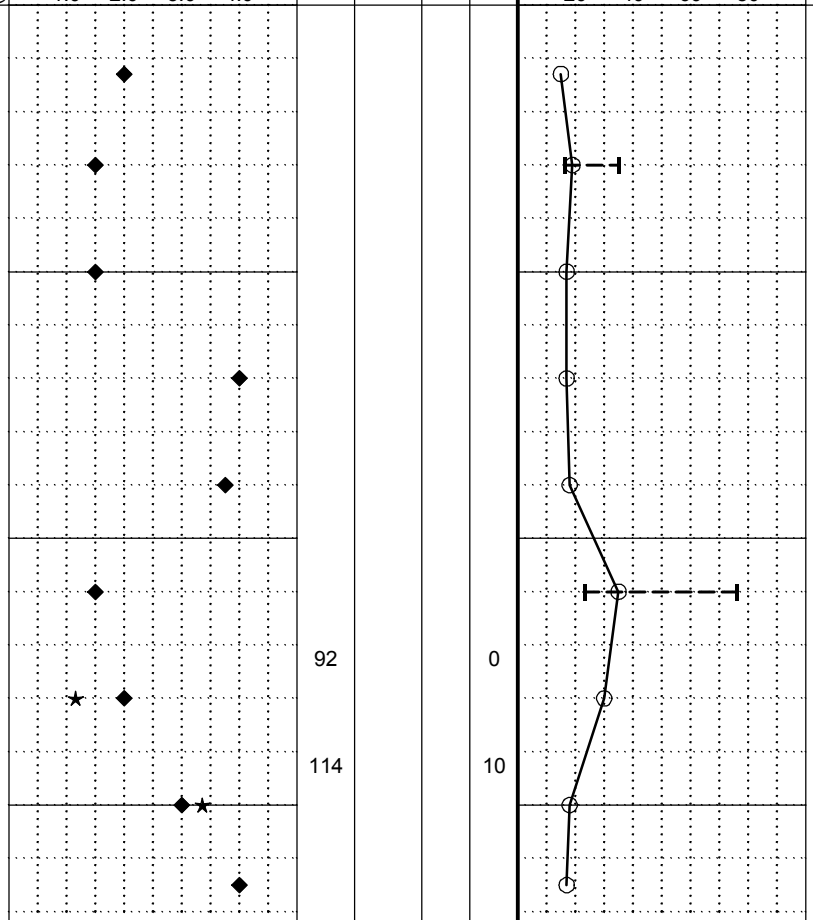
SURFACE ELEVATION: 57.64

LOCATION

Delany St.
Northing: 13862415.27
Easting: 3119253.61

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)
0		3" Asphalt							
		4" Crushed gravel with shell							
		Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0		15				
		..with ferrous nodules below 2'	1.5		19	35	16	19	56
		..with calcareous nodules below 4'	1.5		17				
5	CL	..very stiff below 6'	4.0		17				
			3.75		18				
10		Fat Clay with Sand (CH), stiff, very high plasticity, reddish brown with calcareous nodules	1.5		35	76	23	53	
			2.0	92	30				
	CH	..very stiff with ferrous nodules below 14'	3.0	114	18				
15			4.0		17				

Columns: BLOW COUNT (N, Blows/Foot); UNDRAINED SHEAR STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi); ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 14', After Drilling Water Level: 14.5'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17', Hole Caved at: 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-20 (PZ-2)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/5/2013

SURFACE ELEVATION 58.79

LOCATION

Delany St.
Northing: 13862384.76
Easting: 3119726.06

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
		SM		Silty Sand (SM), non plastic, light gray and tan							10					
											11				31	
				Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.5						13	45	18	27	54	
5																
				..firm below 6'	1.0						10					
		CL														
				..medium plasticity below 8'	1.5		116			0	13	27	15	12		
10				Silty Sand (SM), medium dense, non plastic, light gray and tan		17					19					
						23					19					
		SM														
15						25					21				15	
						28					22					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: Dry, 7 days Water Level: 10.5', 30 days Water Level: 10'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17.5'; PZ water level: Dry (3/06/2013); PZ water level: 10.5' (3/14/2013); PZ water level: 10' (4/10/2013) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-21

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/9/2013

SURFACE ELEVATION: 53.19

LOCATION

Tabor St.
Northing: 13860627.37
Easting: 3117506.14

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				5" Shell												
				Lean Clay with Sand (CL), hard, high plasticity, light gray and tan	4.5						17	41	17	24	72	
					4.5						14					
				..with ferrous nodules below 4'	4.5						12					
5																
					4.5						13					
		CL														
				..very stiff with calcareous nodules below 8'	4.0		107			0	21					
10				..medium plasticity below 10'	2.5						17	34	16	18		
				..stiff below 12'	2.0		112			9	17					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-22 (PZ-4)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

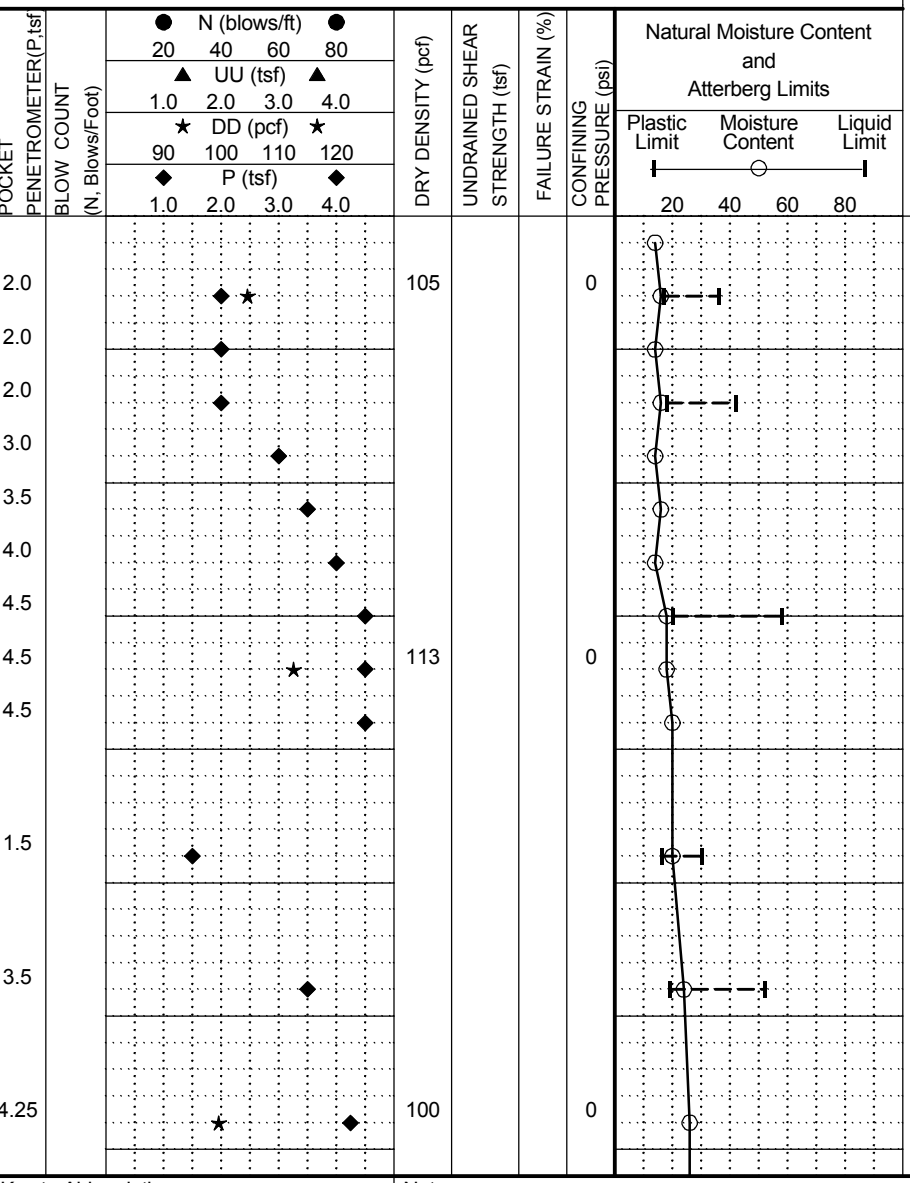
DATE 3/01/2013

SURFACE ELEVATION 53.76

LOCATION

Link Rd. @ White Oak Bayou
Northing: 13860525.73
Easting: 3118142.74

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0	CL	Lean Clay with Sand (CL), medium plasticity, light gray and tan							14					
		..stiff below 2'	2.0		105			0	16	36	17	19	73	(2-4 feet) Crumb=Grade 1
5		..with calcareous nodules below 4'	2.0						14					
			2.0						16	42	18	24	83	(6-8 feet) Crumb=Grade 1
		..very stiff with ferrous nodules below 8'	3.0						14					
10			3.5						16					
			4.0						14					
15	CH	Fat Clay (CH), hard, high plasticity, light gray and tan	4.5						18	58	20	38	90	(14-16 feet) Crumb=Grade 1 Pinhole=ND3
		..with ferrous nodules below 16'	4.5		113			0	18					
			4.5						20					
20														
25	CL	Lean Clay (CL), soft, medium plasticity, light gray and tan	1.5						20	30	16	14	95	(23-25 feet) Crumb=Grade 4
30	CH	Fat Clay (CH), very stiff, high plasticity, reddish brown	3.5						24	52	19	33		
		..with slickensided layers below 33'	4.25		100			0	26					
35														



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 24', After Drilling Water Level: 23', 24 hrs Water Level: 23', 7 days Water Level: 22', 30 days Water Level: 22.5'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70'; PZ water level: 23' (3/02/2013); PZ water level: 22' (3/14/2013); PZ water level: 22.5' (4/10/2013) Drilled By: Van & Sons, Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-22 (PZ-4)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

DATE 3/01/2013

SURFACE ELEVATION 53.76

LOCATION
Link Rd. @ White Oak Bayou
Northing: 13860525.73
Easting: 3118142.74

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
40				..hard below 38'	4.5						26					
45					4.5						23	70	22	48	96	
50				..very stiff below 48' (slickensided)	3.5		106			0	22					
55		CH		hard below 53'	4.5						25					
60					4.5						31					
65				..very stiff below 63' (slickensided)	3.0		88			42	37					
70				..hard, light gray and tan below 68'	4.5						26	63	21	42	96	

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 24', After Drilling Water Level: 23', 24 hrs Water Level: 23', 7 days Water Level: 22', 30 days Water Level: 22.5'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70'; PZ water level: 23' (3/02/2013); PZ water level: 22' (3/14/2013); PZ water level: 22.5' (4/10/2013) Drilled By: Van & Sons, Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-23

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

DATE 3/4/2013

SURFACE ELEVATION 51.18

LOCATION

Enid St. @ White Oak Bayou
Northing: 13860789.83
Easting: 3118176.36

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		CL		Lean Clay with Sand (CL), high plasticity, light gray and tan with shells (FILL 16' feet)							14	45	18	27	71	
				..stiff below 2'	2.0		110			0	17					
5				..very stiff below 4'	3.5						17					
				..with calcareous nodules below 6'	2.5						17	41	17	24	82	(6-8 feet) Crumb=Grade 1 Pinhole=ND1
				..stiff below 8'	2.0		111			0	18	37	17	20	78	(8-10 feet) Crumb=Grade 4
10				..dark gray below 10'	1.5						20					
				..soft, light gray and tan below 12'	0.5		99			9	22	40	17	23	75	(12-14 feet) Crumb=Grade 1
15					1.0						24					
		CH		Fat Clay (CH), hard, high plasticity, reddish brown	4.5						23	69	22	47		
					4.5						20					
20			▼													
			▽	..stiff, light gray and tan below 23'	2.0		104			16	23					(23-25 feet) Crumb=Grade 4
25																
		CL		Lean Clay (CL), stiff, medium plasticity, reddish brown	2.0						23	27	15	12	99	(28-30 feet) Crumb=Grade 4 Pinhole=D1
30																
		CH		Fat Clay (CH), hard, high plasticity, reddish brown	4.5						23	63	21	42	97	
35																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: 24', After Drilling Water Level: 21.5'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70', Hole Grouted after Drilling. Drilled By: Van and Sons , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-23

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

DATE 3/4/2013

SURFACE ELEVATION 51.18

LOCATION

Enid St. @ White Oak Bayou
Northing: 13860789.83
Easting: 3118176.36

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				..stiff below 38' (slickensided)	2.0		101			0	26					
40																
				..hard below 43'	4.5						19	71	22	49	96	
45																
					4.5						22					
50																
		CH		..very stiff with slickensided layers below 53'	4.5		101			0	25					
55																
				..hard with ferrous nodules below 58'	4.5						27					
60																
					4.5						33	74	23	51	97	
65																
				..very stiff, light gray and tan below 68'	4.5		96			48	29					
70																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: 24', After Drilling Water Level: 21.5'

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70', Hole Grouted after Drilling. Drilled By: Van and Sons , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-24

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

DATE 3/4/2013

SURFACE ELEVATION 48.88

LOCATION

Link Rd. @ White Oak Bayou
Northing: 13860526.42
Easting: 3118348.76

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		Sandy Lean Clay (CL), medium plasticity, light gray and tan with shells (FILL 30 feet)							12	33	16	17	53	
									12					
5	CL	..very stiff below 4'	3.0						14	34	16	18	54	(4-6 feet) Crumb=Grade 1
		..firm below 6'	1.0		97			0	15					
		..stiff below 8'	2.0		109			6	15					
10		Fat Clay (CH), stiff, high plasticity, light gray and tan	1.5						24	62	21	41	90	(10-12 feet) Crumb=Grade 1
	CH	..firm below 12'	1.0		105			0	19					
15		..very stiff below 14'	2.5						17					
		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	3.0						16	41	17	24	84	(16-18 feet) Crumb=Grade 1
		..firm below 18'	1.0		110			13	20					
20														
	CL	..stiff with calcareous nodules below 23'	1.5						15	33	16	17	71	(23-25 feet) Crumb=Grade 3
25														
		..very stiff, reddish brown below 28'	3.0		104			20	26	27	15	12	84	(28-30 feet) Crumb=Grade 4
30		Fat Clay (CH), hard, high plasticity, reddish brown												
	CH		4.5						22	56	20	36		
35														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 23', After Drilling Water Level: 21'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70', Hole Grouted after Drilling. Drilled By: Van and Sons , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-24

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G-13-120 BORING TYPE: Auger

DATE 3/4/2013

SURFACE ELEVATION 48.88

LOCATION

Link Rd. @ White Oak Bayou
Northing: 13860526.42
Easting: 3118348.76

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				..very stiff below 38'	3.5		103			0	26					
40																
					4.0						25	66	21	45	99	
45																
				..with slickensided layers below 48'	4.0		96			0	30					
50																
		CH		..hard below 53'	4.5						28					
55																
					4.5						27	79	23	56	98	
60																
				..very stiff with slickensided layers below 63'	4.5		91			0	34					
65																
				..hard below 68'	4.5						30					
70																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 23', After Drilling Water Level: 21'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 70', Hole Grouted after Drilling. Drilled By: Van and Sons , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-25

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/8/2013

SURFACE ELEVATION 52.41

LOCATION

I-45 Frontage Rd.
Northing: 13860411.96
Easting: 3119023.65

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				11" Crushed gravel												
		CH		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan ..with calcareous nodules below 2'	2.75						18					
					2.5						22	57	20	37	77	
				..stiff with ferrous nodules below 4'	1.5						28					
5																
					2.0						31					
					2.0		100			0	26					
10					1.5						21	52	19	33		
		SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		15					20					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13.5', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-26

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

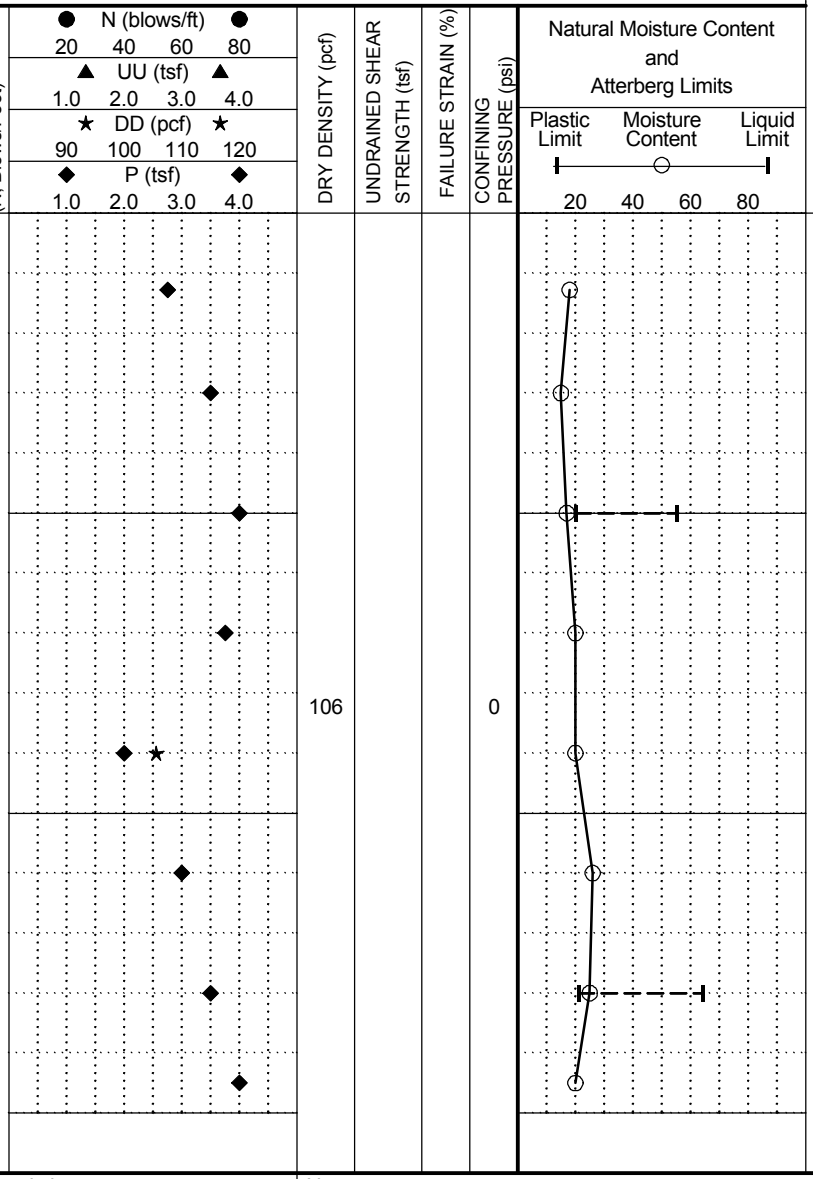
DATE: 4/9/2013

SURFACE ELEVATION: 54.55

LOCATION

Angelo St.
Northing: 13860741.25
Easting: 3119174.53

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				1.25" Asphalt												
				4.5" Concrete												
				1" Sand												
				Fat Clay (CH), very stiff, high plasticity, light gray and tan	2.75						18					
				..with ferrous nodules below 2'	3.5						15					
				..with calcareous nodules below 4'	4.0						17	55	20	35	95	
5																
				..stiff below 6'	3.75						20					
		CH			2.0		106			0	20					
10				..very stiff, reddish brown below 10'	3.0						26					
					3.5						25	64	21	43	96	
					4.0						20					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-27

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

SURFACE ELEVATION: 55.80

LOCATION

Dunlop St.
Northing: 13860808.43
Easting: 3119732.99

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3.5" Asphalt												
				12" Crushed stone												
				Lean Clay with Sand (CL), very stiff, slightly plasticity, light gray and tan	3.5						14	24	15	9	85	
					2.75						18					
					3.75						16					
5				..with sand seam below 6'	3.25						15					
		CL		..stiff below 8'	2.0		108			6	20					
10				..with high plasticity below 10'	2.0		104			0	25	49	19	30		
				..soft below 12'	0.5						22					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-28

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

SURFACE ELEVATION: 53.37

LOCATION

Karcher St.
Northing: 13860195.97
Easting: 3119513.44

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				6" Lime stabilized												
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.5						21					
				..with calcareous nodules below 2'	1.5						23					
					2.0						20	53	19	34	78	
5		CH														
				..with ferrous nodules below 6'	2.0						21					
					2.0						39					
10				Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0						25	30	16	14		
		CL		..firm with calcareous nodules below 12'	1.0		104			0	26					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-29

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/8/2013

SURFACE ELEVATION 52.61

LOCATION

Wynne St.
Northing: 13859975.46
Easting: 3119093.06

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				7" Asphalt												
				13" Crushed gravel												
		CL		Lean Clay with Sand (CL), hard, medium plasticity, light gray and tan	4.5						7	28	15	13	74	
					4.5						11					
				..with calcareous nodules below 4'	4.5						13					
5																
				..with ferrous nodules below 6'	4.5						14					
					4.5						14	47	18	29		
10				..stiff below 10'	2.0		105			0	21					
					2.0						22					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-30

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

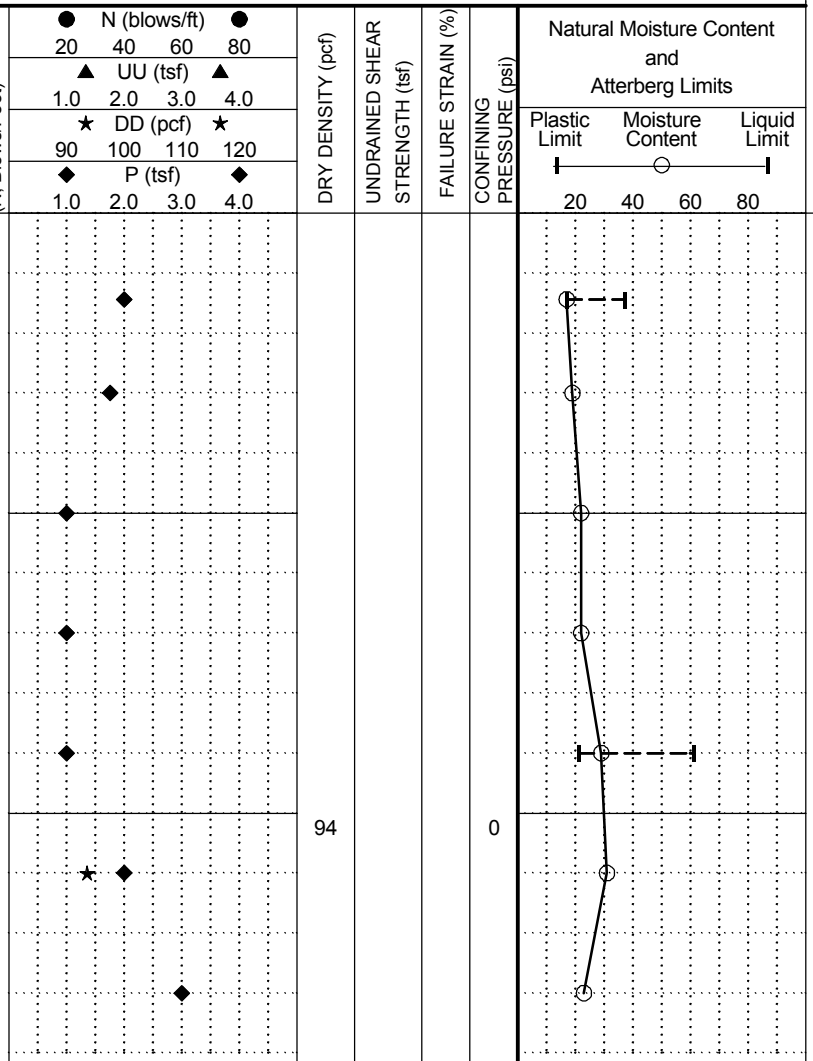
DATE 4/8/2013

SURFACE ELEVATION 53.69

LOCATION

Wynne St.
Northing: 13860019.14
Easting: 3119996.92

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				6.5" Concrete												
				4" Crushed limestone												
		CL		Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0						17	37	17	20	86	
				..with sand seam below 2'	1.75						19					
				..firm with ferrous nodules below 4'	1.0						22					
5					1.0						22					
				Fat Clay (CH), firm, high plasticity, light gray and tan	1.0						29	61	21	40		
10		CH		..stiff with ferrous nodules below 10'	2.0		94			0	31					
				..very stiff below 12'	3.0						23					
				..light hydrocarbon - like odor noted at bottom of sample at 14'												



Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-31

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 3/8/2013

SURFACE ELEVATION: 52.66

LOCATION

I-45 Frontage Rd.
Northing: 13859528.4
Easting: 3119187.59

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				11" Crushed gravel												
		CL		Lean Clay with Sand (CL), very stiff, slight plasticity, light gray and tan	4.0						13	24	15	9	72	
				..stiff with ferrous nodules below 2'	1.5						16					
				..hard with calcareous nodules below 4'	4.5						15					
5																
				..very stiff below 6'	3.75						16					
					3.0						18	48	18	30		
10					3.5		111			0	20					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-32

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/4/2013

SURFACE ELEVATION 50.41

LOCATION

I-45 Frontage Rd.
Northing: 13859073.33
Easting: 3119284.65

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		CL		Lean Clay (CL), very stiff, high plasticity, light gray and tan (Fill 13 feet)	3.5						19	44	18	26	96	
				..with ferrous nodules below 2'	3.0						18					
				..hard with calcareous nodules below 4'	4.5						18					
5					4.5						13					
					4.5						15					
10				..very stiff below 10'	3.5		108			0	17	48	18	30		
				..hard below 12'	4.5						13					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-33

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 58.74

LOCATION

Cortlandt St.
Northing: 13859611.23
Easting: 3111725.39

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				7.25" Concrete												
				5" Sand												
		CL		Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						16	33	16	17	85	
				..with calcareous nodules below 2'	1.5						18					
				..with ferrous nodules below 4'	2.0						18					
5																
					1.5						18					
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0						19	51	19	32		
10		CH		..with ferrous nodules below 10'	2.0		110			0	20					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-34

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

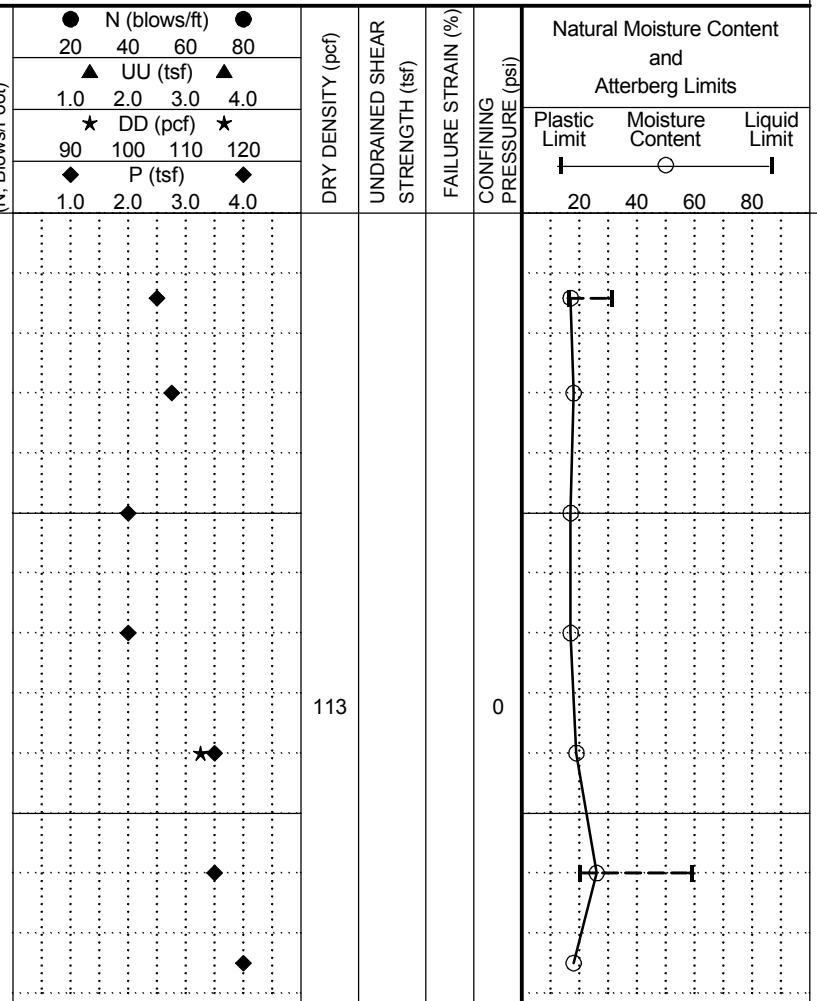
DATE: 4/2/2013

SURFACE ELEVATION: 60.25

LOCATION

Arlington St.
Northing: 13860219.39
Easting: 3112050.32

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				7" Shell												
		CL		Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan	2.5						17	31	16	15	80	
				..with calcareous nodules below 2'	2.75						18					
				..stiff with ferrous nodules below 4'	2.0						17					
5					2.0						17					
					3.5		113			0	19					
10		CH		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.5						26	59	20	39		
				..with ferrous and calcareous nodules below 12'	4.0						18					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-35

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 60.82

LOCATION

Arlington St.
Northing: 13860711.18
Easting: 3112025.98

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				5" Shell												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						17					
				..with calcareous nodules below 2'	2.0						17	34	16	18	76	
				..with ferrous nodules below 4'	1.5						16					
5																
				..firm with sand seam below 6'	1.0						21					
		CL			1.0						22					
10				..stiff below 10'	2.0						23					
				..very stiff below 12'	3.5						16	40	17	23		
					4.0		119			0	17					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-36

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/9/2013

SURFACE ELEVATION 59.32

LOCATION

Aurora St.
Northing: 13861029.65
Easting: 3111759.69

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				9" Shell												
		CL		Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0						17	36	17	19	67	
				..with ferrous and calcareous nodules below 2'	1.5						19					
					3.5						17					
5				..very stiff below 6'	3.0						19					
		CH		Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan with ferrous nodules	2.0						27	62	21	41		
10				..with ferrous nodules below 10'	2.0		107			0	22					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-37

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

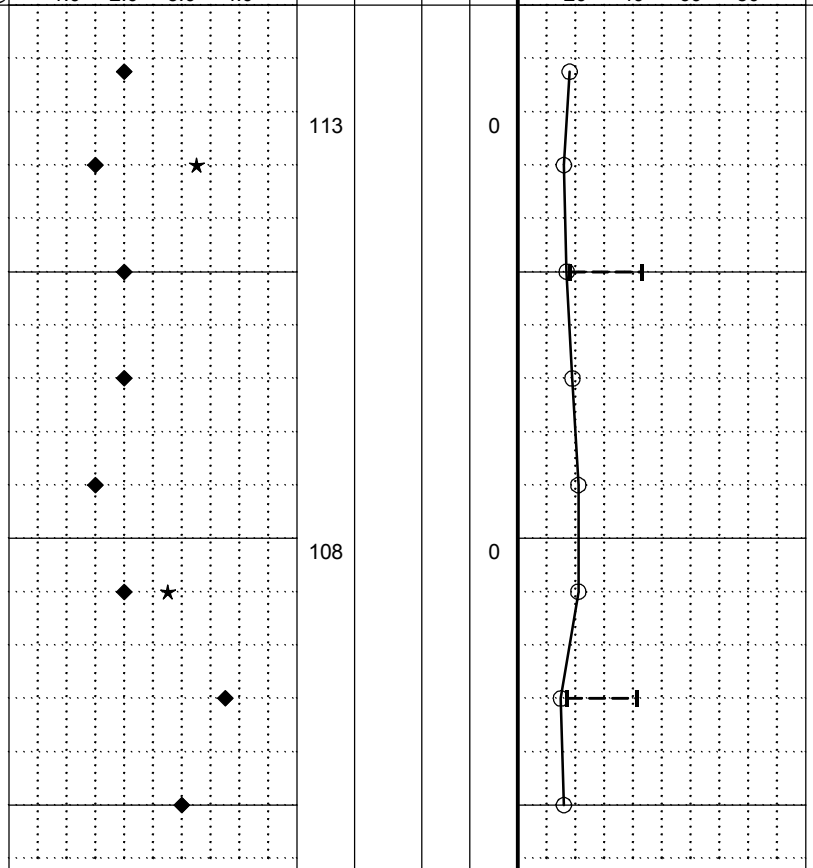
DATE 3/29/2013

SURFACE ELEVATION 60.04

LOCATION

Cortlandt St.
Northing: 13861443.93
Easting: 3111531.12

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				3" Lime stabilized												
				Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	2.0						18					
				..firm with calcareous nodules below 2'	1.5		113			0	16					
				..stiff with ferrous nodules below 4'	2.0						17	43	18	25	82	
5																
					2.0						19					
		CL			1.5						21					
10					2.0		108			0	21					
				..very stiff below 12'	3.75						15	41	17	24	80	
					3.0						16					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-38

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/29/2013

SURFACE ELEVATION 60.39

LOCATION

Cortlandt St.
Northing: 13861998.41
Easting: 3111504.02

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				7" Crushed gravel												
		CL		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	3.5						15	42	18	24	85	
				..with calcareous nodules below 2'	3.0						18					
				..with ferrous nodules below 4'	2.75						19					
5					4.0						17					
					3.5		110			0	19					
10					3.5						18	32	16	16		
					3.0						18					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-39

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/2/2013

SURFACE ELEVATION 60.02

LOCATION

Arlington St.
Northing: 13861261.39
Easting: 3111995.71

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				5" Shell												
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5						13					
				..very stiff with calcareous nodules below 2'	3.5		118			0	13					
					3.0						12	33	16	17	67	
5																
				..with ferrous nodules below 6'	3.5						17					
					4.0						19					
		CL														
10				..with sand seam below 10'	2.5						25					
					4.0		115			0	18					
					3.5						18	49	19	30	69	
15																
					4.0						19					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-40

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

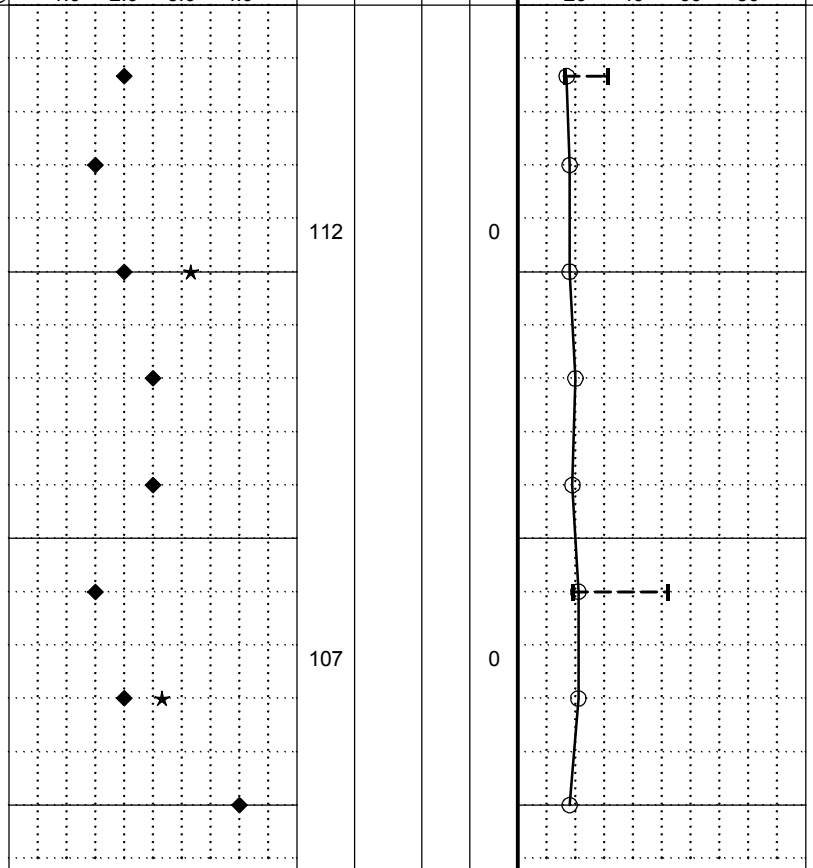
DATE 3/29/2013

SURFACE ELEVATION 59.44

LOCATION

Arlington St.
Northing: 13861726.28
Easting: 3111972.33

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				5" Shell												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						17	31	16	15	71	
				..with calcareous nodules below 2'	1.5						18					
				..with ferrous nodules below 4'	2.0		112			0	18					
5		CL		..very stiff below 6'	2.5						20					
					2.5						19					
10				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.5						21	52	19	33	84	
				..with ferrous nodules below 12'	2.0		107			0	21					
		CH		..very stiff below 14'	4.0						18					
15																



Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: 14', After Drilling Water Level: 14'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Caved at: 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-41

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/29/2013

SURFACE ELEVATION 58.42

LOCATION

Arlington St.
Northing: 13862276.07
Easting: 3111942.85

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				7" Asphalt												
				5" Crushed gravel												
				Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	1.5						18					
				..with ferrous nodules below 2'	2.0		107			0	19					
				..very stiff with calcareous nodules below 4'	2.5						18	41	17	24	84	
5																
					3.0						18					
		CL			2.5						18					
10					3.5		114			0	18					
					3.0						20	43	18	25		
					3.0						19					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-42 (PZ-5)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/6/2013

SURFACE ELEVATION 58.59

LOCATION

Aurora St.
Northing: 13861061.96
Easting: 3112449.24

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	N (blows/ft) 20 40 60 80 / UU (tsf) 1.0 2.0 3.0 4.0 / DD (pcf) 90 100 110 120 / P (tsf) 1.0 2.0 3.0 4.0	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt														
				4" Crushed stone														
				Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	3.0								16	39	17	22	73	
				..with calcareous nodules below 2'	3.0								14					
				..with ferrous nodules below 4'	3.5								18					
5																		
					2.5								21					
		CL			4.0			106			0		21					
10					3.5								17	47	18	29	80	
				..hard below 12'	4.5								17					
				..very stiff below 14'	4.0			114			10		18					
15																		
					2.5								19					

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: Dry, 7 days Water Level: 5.5', 30 days Water Level: 4.5'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17'; PZ water level: Dry (3/07/2013); PZ water level: 5.5' (3/14/2013); PZ water level: 4.5' (4/10/2013) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-43

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 59.65

LOCATION

Oxford St.
Northing: 13860105.47
Easting: 3112752.61

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				4" Crushed gravel												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	1.5						14	31	16	15	76	
					1.5						17					
				..with calcareous nodules below 4'	2.0						16					
5																
				..with ferrous nodules below 6'	2.0						19					
		CL			2.5		110			0	19					
10				..very stiff below 10'	3.0						17	37	17	20		
					4.0						15					

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-44

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

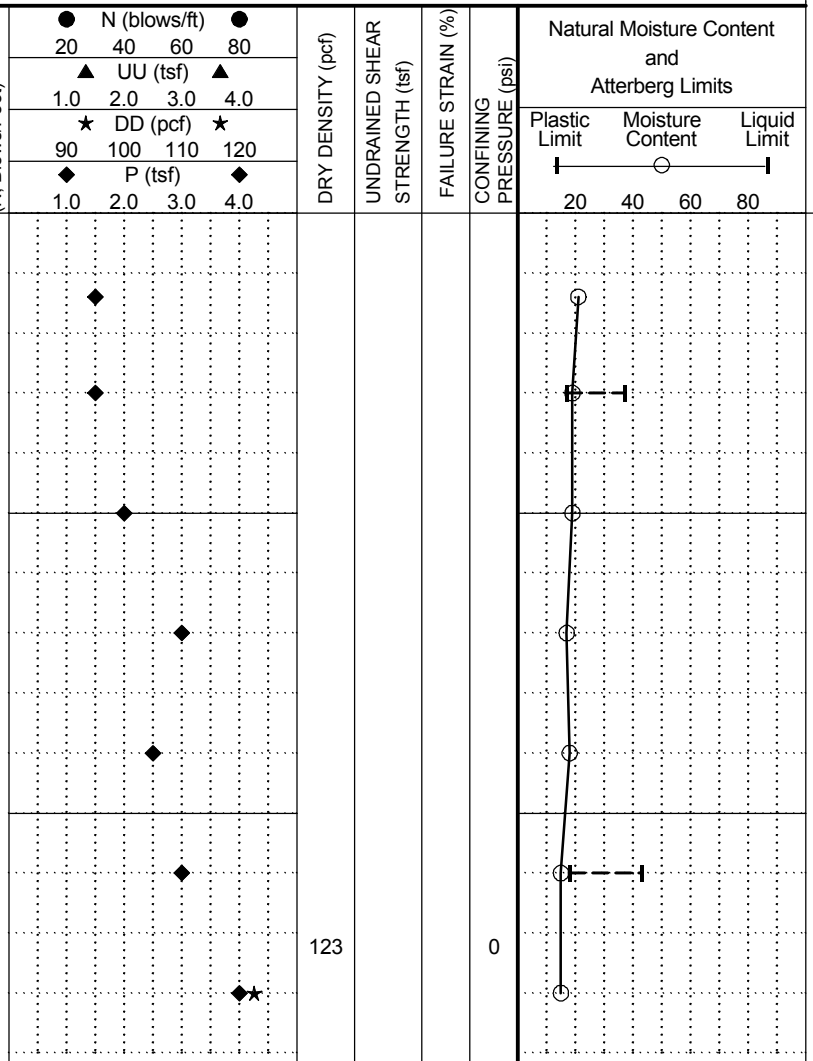
DATE: 4/2/2013

SURFACE ELEVATION: 58.55

LOCATION

Oxford St.
Northing: 13860561.85
Easting: 3112730.92

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4.5" Asphalt												
				5" Shell												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	1.5						21					
				..with calcareous nodules below 2'	1.5						19	37	17	20	74	
				..with sand seam below 4'	2.0						19					
5																
				..very stiff with ferrous nodules below 6'	3.0						17					
		CL			2.5						18					
10				..high plasticity below 10'	3.0						15	43	18	25		
					4.0		123			0	15					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-45

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/2/2013

SURFACE ELEVATION 58.43

LOCATION

E. 22nd St.
Northing: 13859703.07
Easting: 3113151.19

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				7" Shell												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	1.5						19	33	16	17	84	
				..with calcareous nodules below 2'	1.5						18					
				..firm with ferrous nodules below 4'	1.0						18					
5																
		CL		..with sand seam below 6'	1.0						22					
				..stiff with high plasticity below 8'	1.5						21	46	18	28		
10					2.0		106			0	21					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-46

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/9/2013

SURFACE ELEVATION 58.89

LOCATION

Aurora St.
Northing: 13861090.74
Easting: 3112999.1

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				6" Shell												
				Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan ..hard with calcareous nodules below 2'	3.0						15	31	16	15	71	
					4.5						13					
				..stiff with ferrous nodules below 4'	1.75						18					
5																
				..hard below 6'	4.5						13					
		CL		..high plasticity below 8'	4.5						15	45	18	27		
10				..very stiff below 10'	3.5		112			0	17					
				..hard below 12'	4.5						15					
				..very stiff below 14'	3.0		110			10	22					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-47

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

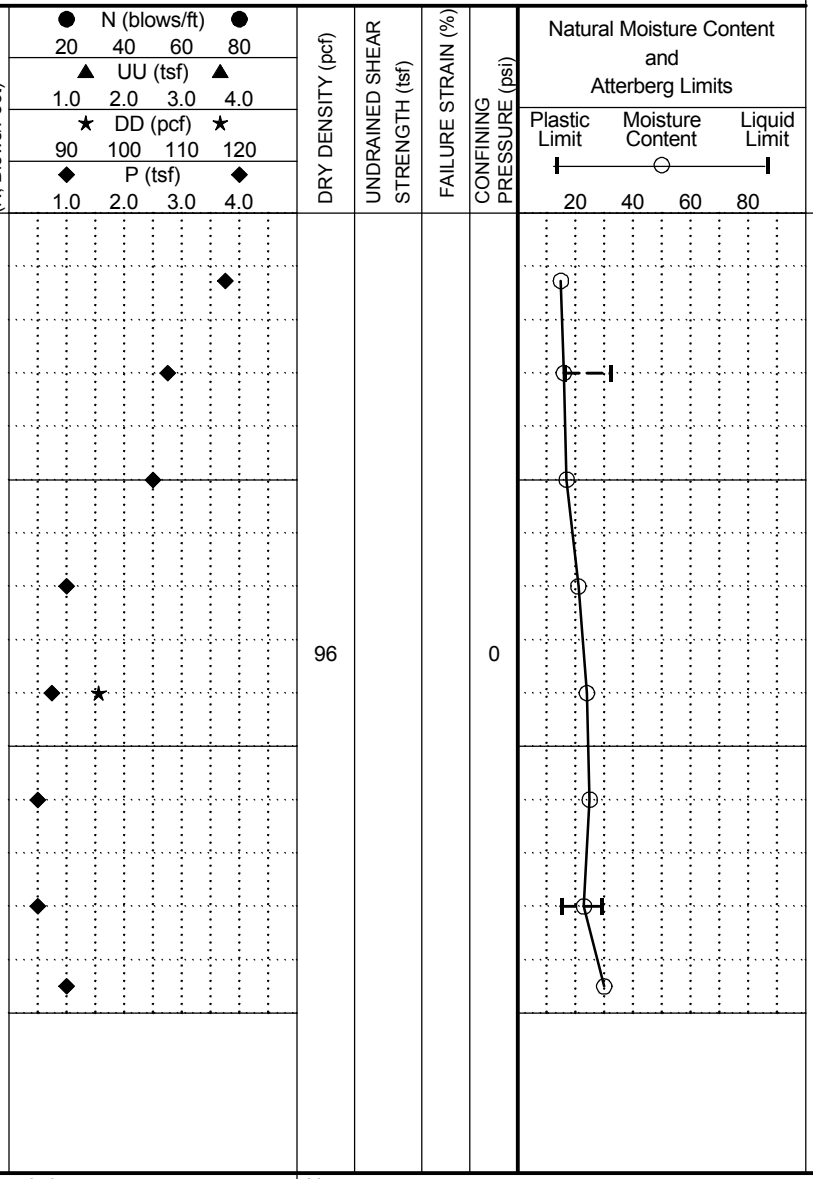
DATE: 4/4/2013

SURFACE ELEVATION: 56.60

LOCATION

Sheldon St.
Northing: 13859432.49
Easting: 3113776.38

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				3.5" Crushed limestone												
				Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.75						15					
				..with calcareous nodules below 2'	2.75						16	32	16	16	67	
				..with ferrous nodules below 4'	2.5						17					
5				..firm with sand seam below 6'	1.0						21					
		CL		..soft below 8'	0.75		96			0	24					
10					0.5						25					
					0.5						23	29	15	14	53	
				..firm below 14'	1.0						30					
15																



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-48

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/9/2013

SURFACE ELEVATION: 55.70

LOCATION

E. 20th St.
Northing: 13859073.58
Easting: 3113710.28

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4.75" Asphalt												
				6.25" Concrete												
		CL		Lean Clay (CL), stiff, slight plasticity, light gray and tan	1.5						17	24	15	9	88	
				..with ferrous nodules below 2'	1.5						20					
				..very stiff with high plasticity below 4'	3.0						17	42	18	24		
5					4.0						18					
		CH		Fat Clay (CH), very stiff, high plasticity, light gray and tan	3.5						18	50	19	31	91	
10				..stiff below 10'	2.5		103			0	23					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-49

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/9/2013

SURFACE ELEVATION 55.63

LOCATION

E. 20th St.
Northing: 13859041.76
Easting: 3114003.58

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				3" Concrete												
				7" Stabilized shell	1.0						20					
		CL		Lean Clay (CL), firm, medium plasticity, light gray and tan	1.0						20	36	17	19	97	
				..stiff below 4'	1.5						17					
5																
				..with ferrous nodules below 6'	2.0						19					
					1.5						17					
10					2.0						20	45	18	27		
		SM		Silty Sand (SM), loose, non plastic, light gray and tan		9					23				47	
15		CH		Fat Clay (CH), stiff, high plasticity, reddish brown (slickensided)	2.0		87			0	34					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 16', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-50

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

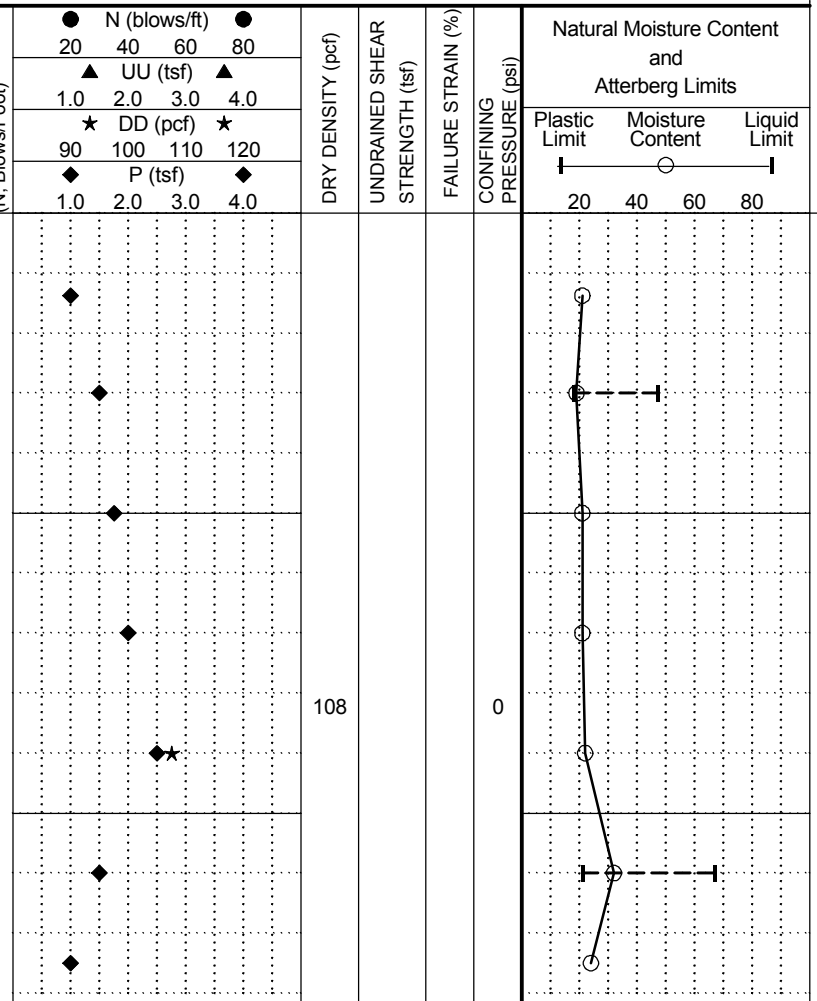
DATE: 4/9/2013

SURFACE ELEVATION: 58.28

LOCATION

E. 20th St.
Northing: 13858920.22
Easting: 3110676.45

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				4" Crushed limestone and shell												
				Lean Clay with Sand (CL), firm, high plasticity, light gray and tan ..with hydrocarbon - like odor to 10' ..stiff below 2'	1.0						21					
					1.5						19	47	18	29	83	
				..with ferrous nodules below 4'	1.75						21					
5		CL														
				..with calcareous nodules below 6'	2.0						21					
					2.5		108			0	22					
10				Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan ..with hydrocarbon - like odor to 13'	1.5						32	67	21	46		
		CH														
		CL		Lean Clay with Sand (CL), firm, high plasticity, light gray and tan ..with hydrocarbon - like odor to 14'	1.0						24					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-51 (PZ-6)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

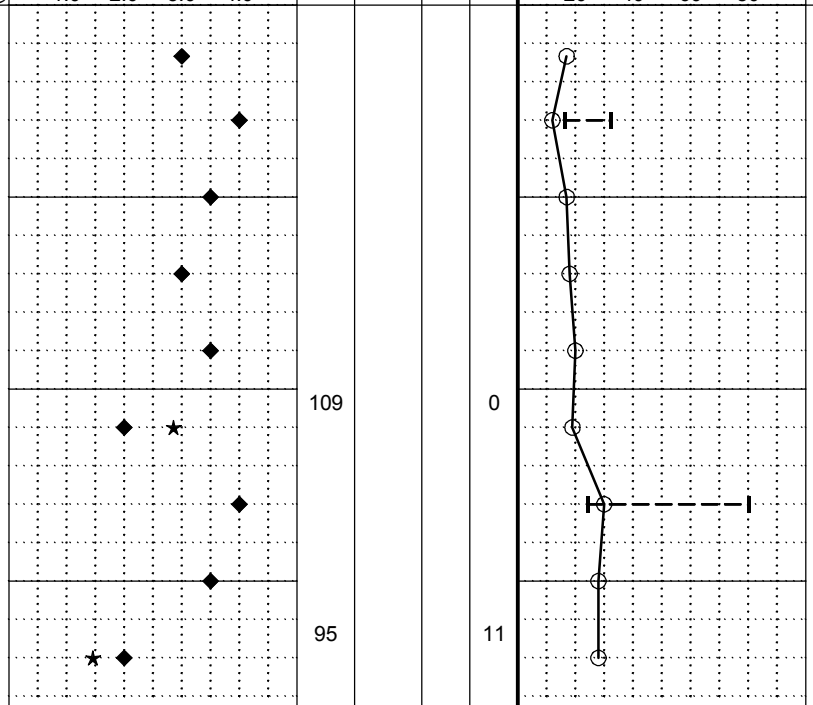
DATE: 3/6/2013

SURFACE ELEVATION: 59.43

LOCATION

E. 20th St.
Northing: 13858929.83
Easting: 3111124.22

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				6" Concrete												
				Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.0						17					
				..with calcareous nodules below 2'	4.0						12	32	16	16	62	
				..with ferrous nodules below 4'	3.5						17					
5		CL			3.0						18					
					3.5						20					
10				..stiff below 10'	2.0		109			0	19					
				Fat Clay (CH), very stiff, very high plasticity, reddish brown with calcareous nodules	4.0						30	80	24	56	94	
					3.5						28					
15		CH		..stiff below 16'	2.0		95			11	28					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: Dry, 7 days Water Level: 10', 30 days Water Level: 9'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 18'; PZ water level: Dry (3/07/2013); PZ water level: 10' (3/14/2013); PZ water level: 9' (4/10/2013) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-52

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/11/2013

SURFACE ELEVATION 58.39

LOCATION

E. 20th St.
Northing: 13858970.24
Easting: 3111705.25

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				1" Concrete												
				5" Shell												
				Fat Clay (CH), stiff, high plasticity, light gray and tan	2.0						20					
				..with calcareous nodules below 2'	2.0						19					
				..with ferrous nodules below 4'	2.0						20	51	19	32	86	
5		CH			2.0						20					
					1.5						23					
10					1.5						21					
				Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	2.5		106			0	21	43	18	25		
		CL		..very stiff with calcareous nodules below 14'	3.5						22					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-53

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/4/2013

SURFACE ELEVATION: 57.52

LOCATION

E. 20th St.
Northing: 13859009.01
Easting: 3112516.94

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				8" Crushed limestone with shell												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						15	37	17	20	79	
				..with calcareous nodules below 2'	2.0		116			0	15					
				..very stiff with ferrous nodules below 4'	4.0						20					
5																
				..stiff below 6'	1.5						23					
		CL		..firm below 8'	1.0						19					
10				..stiff, high plasticity below 10'	2.0						20	46	18	28	83	
				..hard below 12'	4.5						22					
					4.5						24					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-54

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 58.63

LOCATION

Oxford St.
Northing: 13859491.7
Easting: 3112781.55

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				11" Asphalt												
				7" Crushed gravel												
				Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						16					
				..with calcareous nodules below 2'	1.5						19	36	17	19	85	
				..firm below 4'	1.0						19					
5																
				..stiff with ferrous nodules below 6'	2.0						19					
		CL			1.5						19					
10					2.0						21	44	18	26		
				..firm below 12'	1.5		109			0	21					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-55

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 4/9/2013

SURFACE ELEVATION 56.85

LOCATION

E. 20th St.
Northing: 13859043.72
Easting: 3113234.83

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				8.5" Cement stabilized shell												
				Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	1.5						19					
				..with light hydrocarbon - like odor to 15'	2.0						19					
					2.0						19	46	18	28	66	
5																
				..with ferrous nodules below 6'	1.5						20					
		CL			2.0		99			0	28					
10					2.0						31					
				..firm with medium plasticity below 12'	1.0						24	26	15	11	55	
				..very stiff below 14'	3.5						23					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-56

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

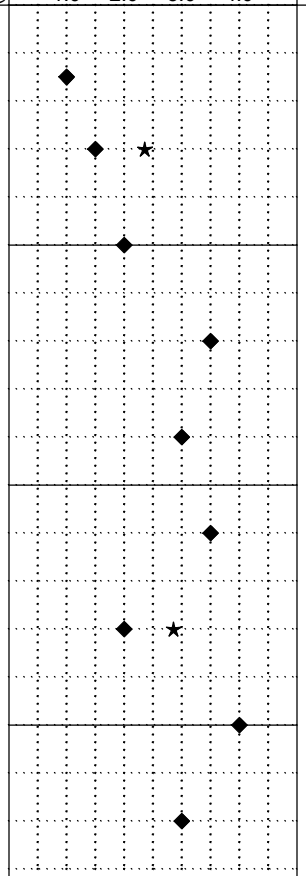
DATE: 4/2/2013

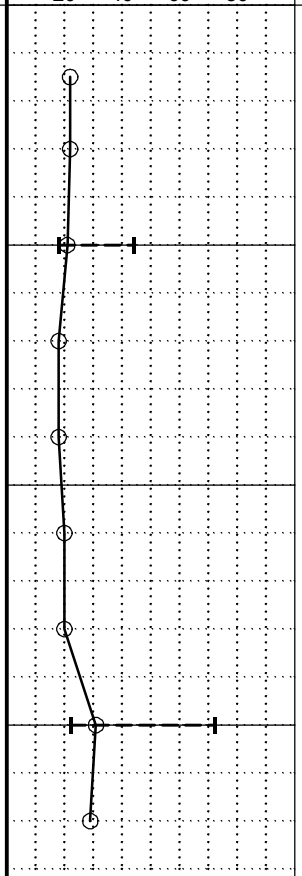
SURFACE ELEVATION: 58.77

LOCATION

Harvard St.
Northing: 13858610.1
Easting: 3111440.45

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				8" Crushed gravel												
				Lean Clay with Sand (CL), firm, high plasticity, dark gray	1.0						22					
				..light gray and tan below 2'	1.5		104			0	22					
				..stiff with ferrous nodules below 4'	2.0						21	44	18	26	84	
5																
				..very stiff below 6'	3.5						18					
		CL			3.0						18					
10					3.5						20					
					2.0		109			0	20					
				Fat Clay (CH), very stiff, very high plasticity, reddish brown and light gray	4.0						31	72	22	50	95	
15		CH		..with calcareous nodules below 16'	3.0						29					





Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 18', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-57

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 58.99

LOCATION

Arlington St.
Northing: 13858394.16
Easting: 3112151.31

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				5" Crushed gravel												
		CL		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	1.5						22	44	18	26	82	
				..with calcareous nodules below 2'	2.0						19					
				..with ferrous nodules below 4'	1.5						18					
5																
					2.0						17					
				Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan with calcareous nodules	3.0						18	51	19	32		
10		CH		..stiff with ferrous nodules below 10'	2.0		108			0	23					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-58

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

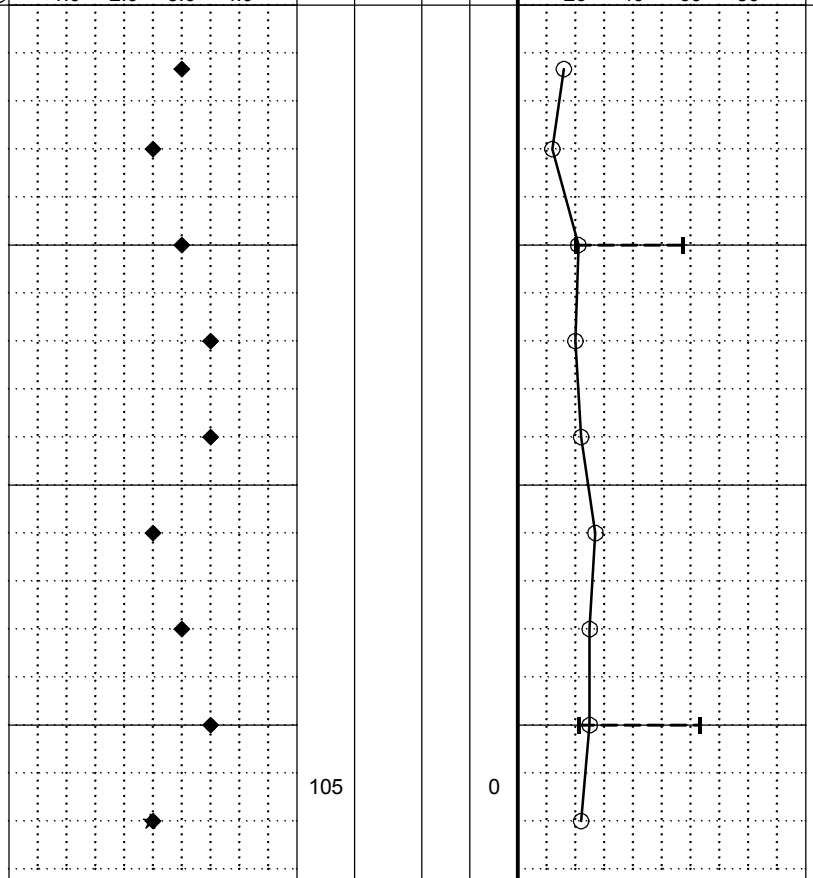
DATE: 4/4/2013

SURFACE ELEVATION: 58.21

LOCATION

E. 18th St.
Northing: 13858169.96
Easting: 3110583.51

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				5" Crushed gravel and shell												
				Fat Clay (CH), very stiff, high plasticity, light gray and tan	3.0						16					
				..with calcareous nodules below 2'	2.5						12					
					3.0						21	57	20	37	95	
5																
				..with ferrous nodules below 6'	3.5						20					
					3.5						22					
		CH														
10					2.5						27					
				..reddish brown below 12'	3.0						25					
				..very high plasticity below 14'	3.5						25	63	21	42	99	
15																
				..stiff below 16'	2.5		105			0	22					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 18', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-59

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

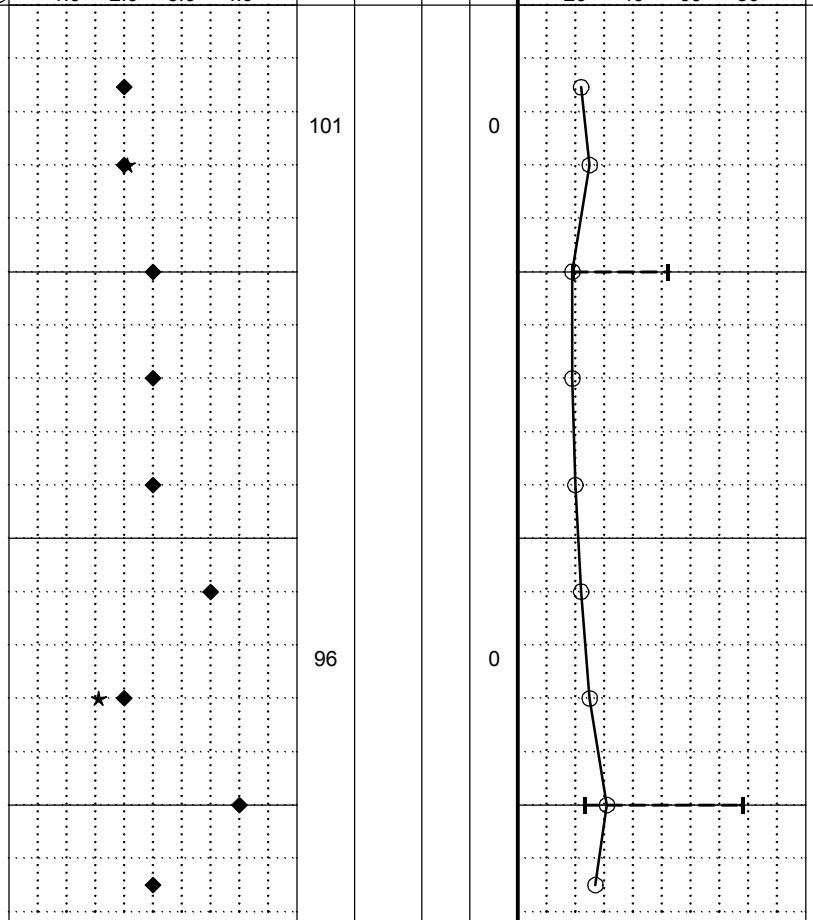
DATE: 4/4/2013

SURFACE ELEVATION: 58.26

LOCATION

E. 18th St.
Northing: 13858199.67
Easting: 3111156.87

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				8" Crushed gravel												
				Fat Clay (CH), stiff, high plasticity, dark gray	2.0						22					
				..light gray and tan below 2'	2.0		101			0	25					
				..very stiff below 4'	2.5						19	52	19	33	87	
5																
				..with ferrous nodules below 6'	2.5						19					
					2.5						20					
		CH														
10					3.5						22					
				..stiff below 12' (slickensided)	2.0		96			0	25					
				..very stiff, very high plasticity, reddish brown below 14'	4.0						31	78	23	55	96	
15			▽													
					2.5						27					



Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 15', After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17', Hole Caved at: 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-60

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/29/2013

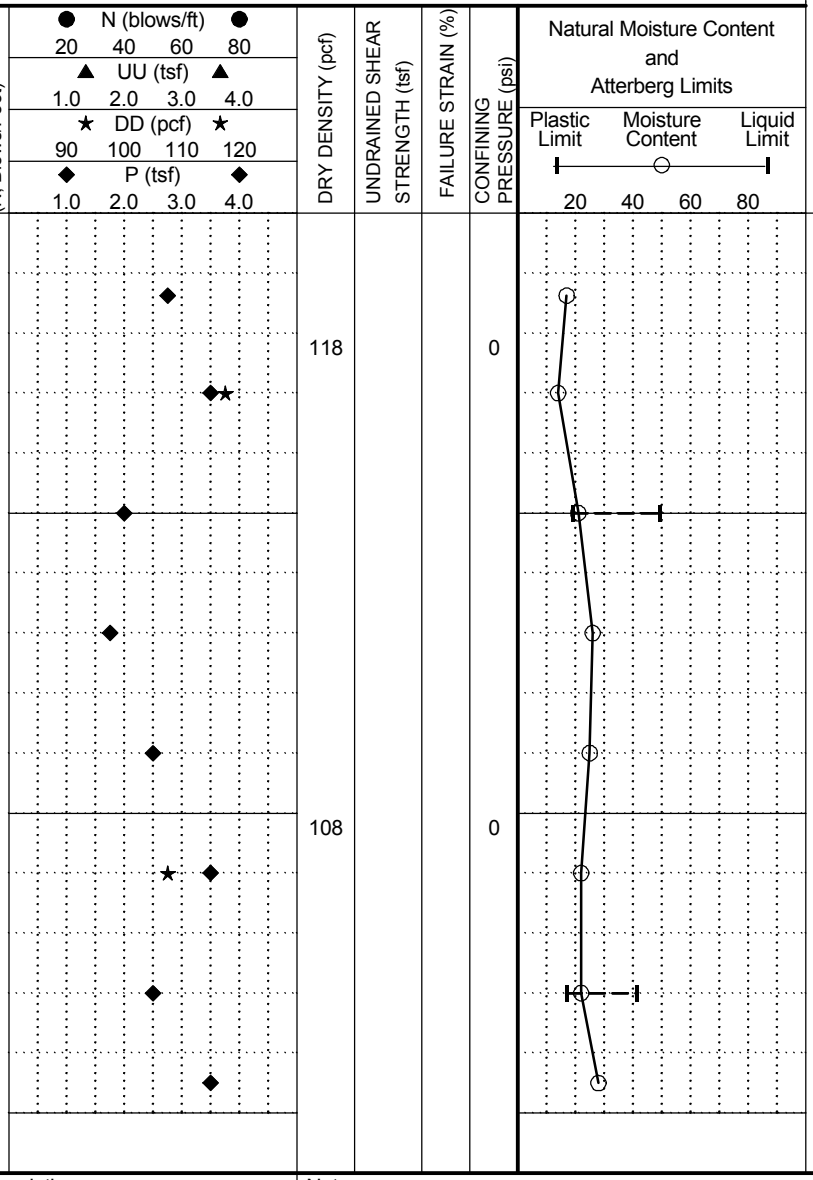
SURFACE ELEVATION 57.84

LOCATION

E. 18th St.
Northing: 13858234.82
Easting: 3111864.3

MATERIAL DESCRIPTION

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				6" Crushed gravel												
				Lean Clay (CL), very stiff, high plasticity, light gray and tan	2.75						17					
				..with calcareous nodules below 2'	3.5		118			0	14					
				..stiff with ferrous nodules below 4'	2.0						21	49	19	30	92	
5																
					1.75						26					
		CL		..very stiff below 8'	2.5						25					
10					3.5		108			0	22					
			▼		2.5						22	41	17	24	89	
			▽													
					3.5						28					
15																



Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: 13', After Drilling Water Level: 12'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Caved at: 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-61

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE 3/29/2013

SURFACE ELEVATION 57.86

LOCATION

E. 18th St.
Northing: 13858258.14
Easting: 3112453.26

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				7" Asphalt												
				3" Crushed gravel												
		CL		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	2.5						14	38	17	21	75	
				..with calcareous nodules below 2'	3.5						16					
				..stiff with ferrous nodules below 4'	2.0		113			0	17					
5				..with sand seam below 6'	1.5						22					
					2.0						23					
10				Fat Clay (CH), stiff, very high plasticity, light gray and tan	1.75						28	65	21	44	98	
		CH	▼	..firm with calcareous nodules below 12'	1.25		105			0	23					
				..very stiff below 14'	2.5						16					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: 12.5', After Drilling Water Level: 12.5'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Caved at: 14', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-62

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 57.64

LOCATION

Harvard St.
Northing: 13857732.89
Easting: 3111482.61

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				4" Crushed gravel												
				Fat Clay (CH), very stiff, high plasticity, light gray and tan	2.5						20	57	20	37	89	
					2.75						23					
				..with calcareous nodules below 4'	3.0						19					
5																
		CH		..with ferrous nodules below 6'	3.5						17					
					2.5						22	55	20	35		
10				..stiff below 10'	2.0		101			0	25					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-63

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 58.46

LOCATION

E. 16th St.
Northing: 13857488.47
Easting: 3111899.41

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				10" Crushed gravel												
				Lean Clay (CL), stiff, high plasticity, light gray and tan	2.0						15					
					2.0		104			0	19					
					1.5						18	45	18	27	93	
5				with sand seam below 6'	2.0						18					
		CL		..very stiff with ferrous nodules below 8'	3.0						17					
10					3.0						20					
					2.5						18					
					3.5						18	41	17	24		
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-64

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 57.62

LOCATION

E. 16th St.
Northing: 13857521.42
Easting: 3112477.75

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				7" Crushed gravel												
				Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	2.5						13					
				..with calcareous nodules below 2'	3.0						12	33	16	17	64	
				..with ferrous nodules below 4'	3.0						13					
5																
		CL			2.5						20					
				..stiff below 8'	2.0						31					
10					2.0						22	36	17	19		
				..firm below 12'	1.5		116			0	16					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-65

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/3/2013

SURFACE ELEVATION: 57.14

LOCATION

Arlington St.
Northing: 13856766
Easting: 3112207.11

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				6" Crushed limestone and shell												
				Fat Clay (CH), stiff, very high plasticity, light gray and tan	1.75						29	67	21	46	98	
					2.0						26					
				..with ferrous nodules below 4'	1.75						23					
5																
		CH		..very stiff below 6'	3.5						24					
				..with calcareous nodules below 8'	4.0						29	60	20	40		
10				..stiff below 10'	2.0		96			0	27					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-66 (PZ-7)

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

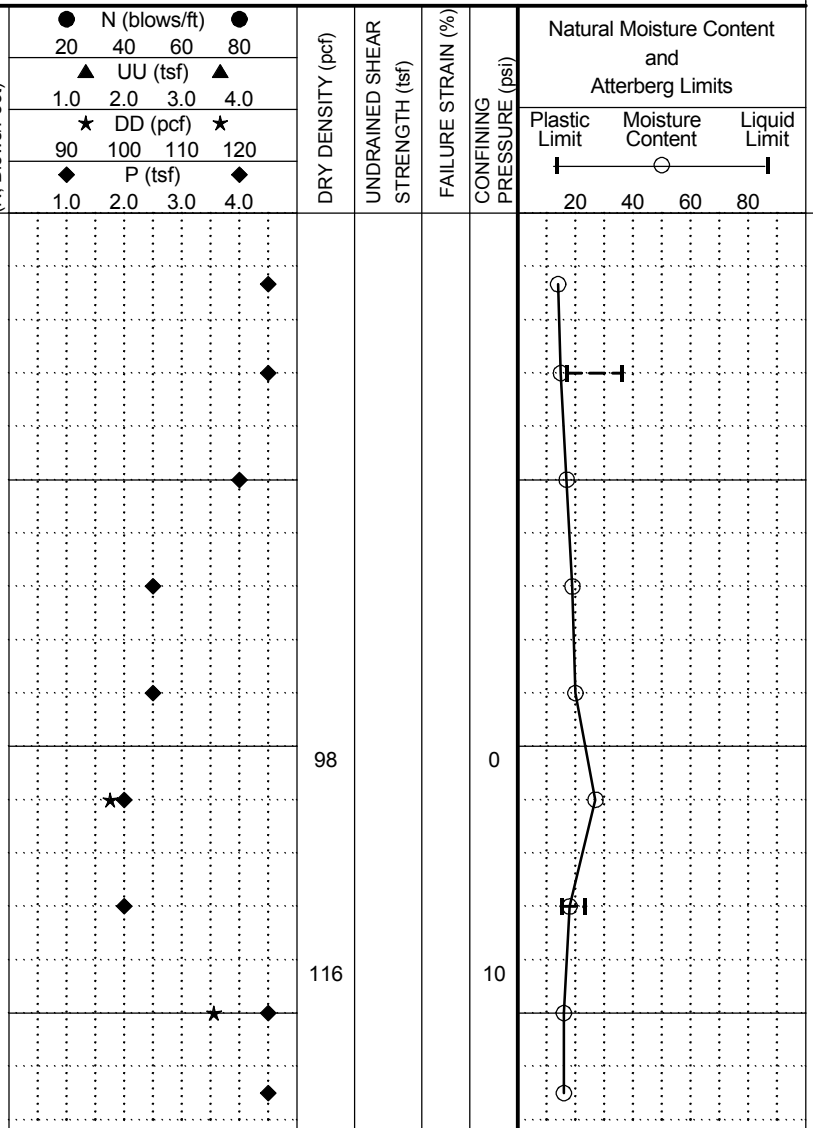
DATE 3/6/2013

SURFACE ELEVATION 56.58

LOCATION

Arlington St.
Northing: 13856168.17
Easting: 3112206.24

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				6" Concrete												
				Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5						14					
				..with calcareous nodules below 2'	4.5						15	36	17	19	92	
				..very stiff below 4'	4.0						17					
5				..with sand seam below 6'	2.5						19					
				..with ferrous nodules below 8'	2.5						20					
		CL														
10				..stiff below 10'	2.0		98			0	27					
					2.0						18	23	15	8	86	
				..very stiff below 14'	4.5		116			10	16					
15				..hard below 16'	4.5						16					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: Dry, 7 days Water Level: 6', 30 days Water Level: 5'
Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 17'; PZ water level: Dry (3/07/2013); PZ water level: 6' (3/14/2013); PZ water level: 5' (4/10/13) Drilled By: Van & Sons, Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-67

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 56.85

LOCATION

Arlington St.
Northing: 13855574.3
Easting: 3112264.85

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		4" Asphalt												
		5" Crushed stone												
	CL	Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan	3.75						14	31	16	15	75	
			4.0						15					
		..with ferrous nodules below 4'	4.0						15					
5														
		..with calcareous nodules below 6'	2.5						18					
		..stiff below 8'	2.0						18	48	18	30		
10		..firm below 10'	1.0		111			0	17					
	SM	Silty Sand (SM), medium dense, non plastic, light gray and tan (wet)		27					21				20	

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 11.5', After Drilling Water Level: 9'

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Caved at: 10.5', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-68

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 56.88

LOCATION

Arlington St.
Northing: 13855040.08
Easting: 3112310.4

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				7" Crushed shell and gravel												
				Lean Clay (CL), stiff, medium plasticity, light gray and tan	1.5						19	35	16	19	95	
				..very stiff below 2'	3.0						19					
				..with ferrous nodules below 4'	3.5						19					
5		CL			4.0						20					
				..high plasticity below 8'	4.0						18	45	18	27		
10				..stiff below 10'	2.5		104			0	21					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-69

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 56.96

LOCATION

Arlington St.
Northing: 13854679.18
Easting: 3112326.43

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				3" Asphalt												
				5" Crushed gravel												
				Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan	4.0						12	35	16	19	84	
				..with calcareous nodules below 2'	4.0						12					
					3.5						16					
5		CL		..with ferrous nodules below 6'	3.0						19					
				..high plasticity below 8'	2.5						18	48	18	30		
10				..stiff below 10'	2.0		110			0	18					
		SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		18					20				43	

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: 14', After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 14', Hole Caved at: 12.5', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-70

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/2/2013

SURFACE ELEVATION: 55.46

LOCATION

Arlington St.
Northing: 13854209.42
Easting: 3112349.26

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				6" Asphalt												
				7" Crushed gravel												
				Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan	2.5						16					
				..with ferrous nodules below 2'	2.5						17	37	17	20	83	
					3.0						17					
5																
					3.5						17					
		CL			2.75						21					
10					3.5						22					
				..stiff, high plasticity below 12'	2.0		93			0	32	40	17	23		
				..firm below 14'	1.0						26					
15																

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 15', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-71

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

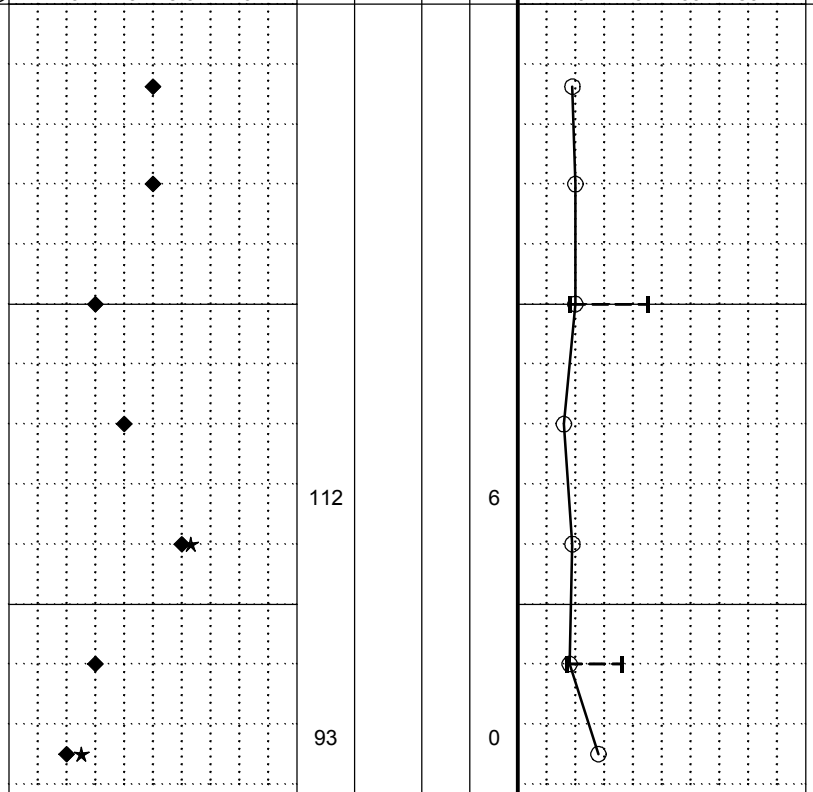
DATE: 4/25/2013

SURFACE ELEVATION: 55.61

LOCATION

E. 12th 1/2 St.
Northing: 13855199.42
Easting: 3113103.09

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				5" Crushed gravel and shell												
		CL		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan (Fill 4 feet)	2.5						19					
					2.5						20					
				Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	1.5						20	45	18	27	71	
5																
				..with ferrous nodules below 6'	2.0						16					
		CL		..very stiff below 8'	3.0		112			6	19					
10				..stiff below 10'	1.5						18	36	17	19		
				..firm below 12'	1.0		93			0	28					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-72

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

DATE: 4/25/2013

SURFACE ELEVATION: 55.85

LOCATION

E. 12th 1/2 St.
Northing: 13855213.06
Easting: 3113530.85

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				4" Asphalt												
				6" Crushed gravel and shell												
				Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan (Fill 8 feet)	2.0						15	32	16	16	59	
					1.5						20					
		CL		..firm with calcareous nodules below 4'	1.0						18					
5				..stiff below 6'	1.5						17					
				Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan	2.0						23	62	21	41		
10		CH		..firm below 10'	1.5		100			0	25					

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

N (blows/ft) 20 40 60 80; UU (tsf) 1.0 2.0 3.0 4.0; DD (pcf) 90 100 110 120; P (tsf) 1.0 2.0 3.0 4.0

Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling
Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-73

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston,TX
WBS No. S-000035-0182-3

PROJECT NO.: G13-120 BORING TYPE: Auger

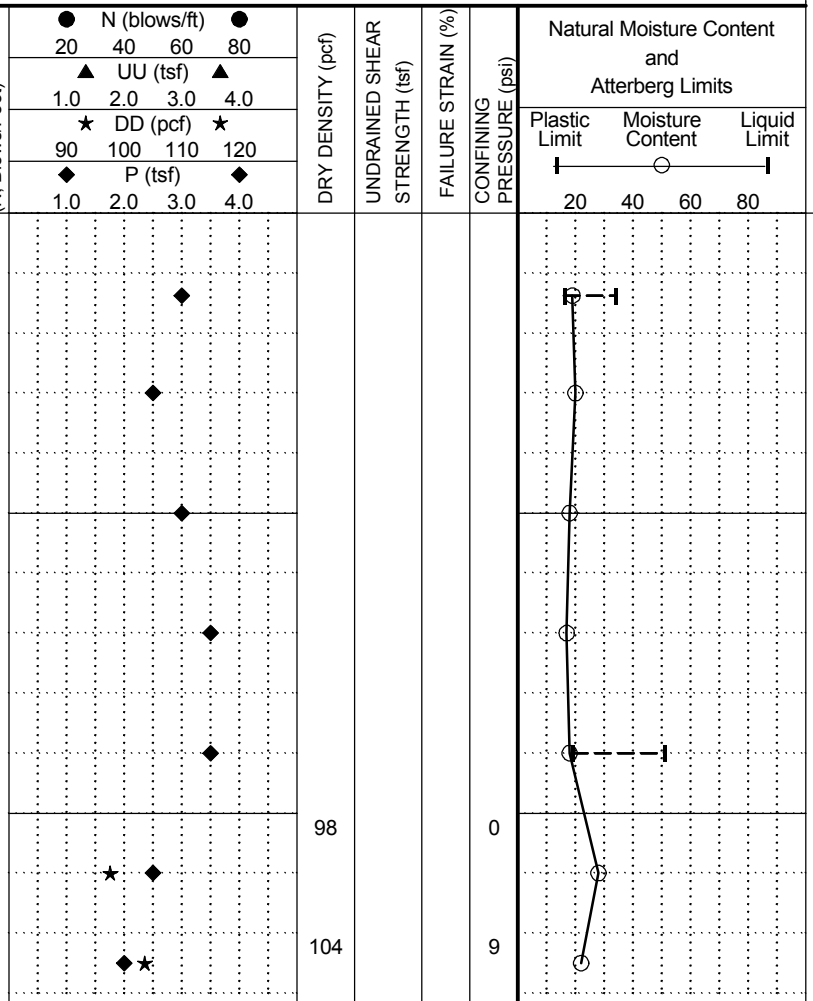
DATE 4/25/2013

SURFACE ELEVATION 55.08

LOCATION

E. 12th 1/2 St.
Northing: 13855241.4
Easting: 3114085.16

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNDRAINED SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				5" Asphalt												
				4" Crushed gravel												
		CL		Lean Clay with Sand (CL), very stiff, medium plasticity, dark gray (Fill 4 feet) ..with calcareous nodules below 2'	3.0						19	34	16	18	70	
					2.5						20					
				Lean Clay with Sand (CL), very stiff, medium plasticity, light gray and tan	3.0						18					
5		CL		..with ferrous nodules below 6'	3.5						17					
				Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.5						18	51	19	32		
10		CH		..stiff with ferrous nodules below 10'	2.5		98			0	28					
					2.0		104			9	22					



Water Level Intial: After Drilling: 24 Hrs:
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: SPT Shelby Tube Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered to 13', Hole Grouted after Drilling. Drilled By: Johnson and Sons , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

APPENDIX 4

RESULTS OF CRUMB, PINHOLE, GRAIN SIZE ANALYSES WITH HYDROMETER AND TRIAXIAL CONSOLIDATED-UNDRAINED TESTS

ASSOCIATED TESTING & LABORATORIES, INC

CRUMB TEST FOR DETERMINATION OF DISPERSIBILITY OF SOILS
ASTM D 6572, METHOD A

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston, Texas

PROJECT NO : G 13 - 120

DATE : 3/8/2013

LOCATION: B-22, B-23

CLIENT: Cobb, Findley & Associates, Inc

SPECIMEN DATA:

[ ] *DISTURBED* [√] *UNDISTURBED*

SPECIMEN TYPE: [√] *NATURAL IRREGULARLY SHAPED CRUMB*

[ ] *REMOLDED CRUMB CUBE*

MOISTURE CONTENT: [√] *NATURAL MOISTURE* [ ] *AIR DRIED*

[ ] *DISTILLED WATER ADDED TO REMOLD SPECIMEN*

CURING TIME : 0 *MIN*

WATER USED : [√] *DISTILLED WATER*

[ ] *DISTILLED AND DEMINERALIZED WATER*

INITIAL WATER TEMPERATURE : 20.1
FINAL WATER TEMPERATURE : 20.5

TIME AT BEGINNING OF TEST : 9:00 [√] *AM* [ ] *PM*

TESTED BY : J.G **DATE TESTED :** 3/8/2013
CHECKED BY : PST **DATE :**

TEST CONDITION

BORING NO.	DEPTH (FT)	2-MINUTE		1 HOUR		6 HOUR		DATE
		GRADE *	C	GRADE*	C	GRADE*	C	
B-22	2'-4'	1	20.1	1	20.5	1	20.5	3/8/2013
B-22	6'-8'	1	20.1	1	20.5	1	20.5	3/8/2013
B-22	14'-16'	1	20.1	1	20.5	1	20.5	3/8/2013
B-22	23'-25'	3	20.1	4	20.5	4	20.5	3/8/2013
B-23	6'-8'	1	20.1	1	20.5	1	20.5	3/8/2013
B-23	8'-10'	3	20.1	4	20.5	4	20.5	3/8/2013
B-23	12'-14'	1	20.1	1	20.5	1	20.5	3/8/2013
B-23	23'-25'	3	20.1	4	20.5	4	20.5	3/8/2013
B-23	28'-30'	3	20.1	4	20.5	4	20.5	3/8/2013

* *GRADE 1 - NON DISPERSIVE* *GRADE 3 - DISPERSIVE*
GRADE 2 - INTERMEDIATE *GRADE 4 - HIGHLY DISPERSIVE*

ASSOCIATED TESTING & LABORATORIES, INC

CRUMB TEST FOR DETERMINATION OF DISPERSIBILITY OF SOILS
ASTM D 6572, METHOD A

PROJECT: Proposed Water Line Replacement in Inner Loop North Area Houston, Texas

PROJECT NO : G 13 - 120

DATE : 3/8/2013

LOCATION: B-24

CLIENT: Cobb, Findley & Associates, Inc

SPECIMEN DATA:

[ ] *DISTURBED* [√] *UNDISTURBED*

SPECIMEN TYPE: [√] *NATURAL IRREGULARLY SHAPED CRUMB*

[ ] *REMOLDED CRUMB CUBE*

MOISTURE CONTENT: [√] *NATURAL MOISTURE* [ ] *AIR DRIED*

[ ] *DISTILLED WATER ADDED TO REMOLD SPECIMEN*

CURING TIME : 0 *MIN*

WATER USED : [√] *DISTILLED WATER*

[ ] *DISTILLED AND DEMINERALIZED WATER*

INITIAL WATER TEMPERATURE : 20.1
FINAL WATER TEMPERATURE : 20.5

TIME AT BEGINNING OF TEST : 9:00 [√] *AM* [ ] *PM*

TESTED BY : J.G **DATE TESTED :** 3/8/2013
CHECKED BY : PST **DATE :**

TEST CONDITION

BORING NO.	DEPTH (FT)	2-MINUTE		1 HOUR		6 HOUR		DATE
		GRADE *	C	GRADE*	C	GRADE*	C	
B-24	4'-6'	1	20.1	1	20.5	1	20.5	3/8/2013
B-24	10'-12'	1	20.1	1	20.5	1	20.5	3/8/2013
B-24	16'-18'	1	20.1	1	20.5	1	20.5	3/8/2013
B-24	23'-25'	1 / 2	20.1	3	20.5	3	20.5	3/8/2013
B-24	28'-30'	4	20.1	4	20.5	4	20.5	3/8/2013

* *GRADE 1 - NON DISPERSIVE* *GRADE 3 - DISPERSIVE*
GRADE 2 - INTERMEDIATE *GRADE 4 - HIGHLY DISPERSIVE*

ASSOCIATED TESTING LABORATORIES, INC

PINHOLE DISPERSION TEST
ASTM D4647 Method A

PROJECT: Proposed Water Line Replacement in Inner Loop North Area, Houston, Texas

PROJECT NO: G13-120

LOCATION:

DATE OF TEST: *3/5/2013*

CLIENT: Cobb, Findley & Associates, Inc

BORING NO:	B-22
DEPTH:	14'-16'
TYPE OF MATERIAL:	Fat Clay (CH)
CLASSIFICATION:	ND 3

SPECIMEN DATA

SPECIMEN	*WATER CONTENT (%)*	*UNIT WEIGHT (PCF)*	*LIQUID LIMIT*	*PLASTIC LIMIT*	*PLASTICITY INDEX*	*-200 SIEVE(%)*
Undistured Soil Sample	18	N/A	58	20	38	90

TEST CONDITIONS

HYDRAULIC HEAD (Inch)	RATE OF FLOW (ML/SEC)	TURBIDITY		TIME OF TEST (MIN)	NEEDLE PUNCH HOLE (MM)	FINAL HOLE	EFFLUENT
		SIDE	TOP				
7"	1.47	barely visible	slightly Dark	15 mins	1 mm	1.8 mm	distilled water

ESTABLISHED 1959

PERFORMANCE BY : J.G

REVIEWED BY : PST

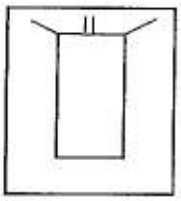
Associated Testing Laboratories, Inc
3143 Yellowstone Blvd
Houston, Texas 77054

ASSOCIATED TESTING LABORATORIES, INC
PINHOLE DISPERSION TEST DATA
ASTM D 4647, Method A

Project No. : G13-120
Boring No. : B-22
Sample Depth, ft : 14'-16'

Date Test: 3/5/2013
Operator: J.G

Water Content: 18
Curing Time: N/A
Effluent: Distilled Water
Compaction Characteristics: N/A



Specimen after test
Final Hole Diameter

1.8 mm

Flow Started on : 1 trial

Classification : ND 3

Clock Time	Head		Flow		Flow Rate, ml/sec	Turbidity from side					From Top	Remarks (reference to number of particles falling)
	in.	mm	ml	sec		Very Dark	Distinctly Dark	Very Slightly Dark	Barely Visible	Completely Clear	Slightly dark	
10:00	2"	50	10	14	0.71				√		√	Yes
10:01			10	14	0.71				√		√	Yes
10:03			10	13	0.77				√		√	Yes
9:04			10	13	0.77				√		√	Yes
10:05	2"	50	10	13	0.77				√		√	Yes
10:07			10	13	0.77				√		√	Yes
10:08			10	13	0.77				√		√	Yes
10:09			10	13	0.77				√		√	Yes
10:10	7"	180	10	8	1.25				√		√	Yes
10:12			10	8	1.25				√		√	Yes
10:13			25	17	1.47				√		√	Yes
10:14			25	17	1.47				√		√	Yes

PERFORMANCE BY : J.G

REVIEWED BY : PST

Comments: Moderately to Slightly Dispersive Soil

Associated Testing Laboratories, Inc
3143 Yellowstone Blvd
Houston.Texas 77054

ASSOCIATED TESTING LABORATORIES, INC

PINHOLE DISPERSION TEST
ASTM D4647 Method A

PROJECT: Proposed Water Line Replacement in Inner Loop North Area, Houston, Texas

PROJECT NO: G13-120

LOCATION:

DATE OF TEST: *3/5/2013*

CLIENT: Cobb, Findley & Associates, Inc

BORING NO:	B-23
DEPTH:	6'-8'
TYPE OF MATERIAL:	Lean Clay with Sand (CL)
CLASSIFICATION:	ND 1

SPECIMEN DATA

SPECIMEN	*WATER CONTENT (%)*	*UNIT WEIGHT (PCF)*	*LIQUID LIMIT*	*PLASTIC LIMIT*	*PLASTICITY INDEX*	*-200 SIEVE(%)*
Undistured Soil Sample	17	N/A	41	17	24	82

TEST CONDITIONS

HYDRAULIC HEAD (Inch)	RATE OF FLOW (ML/SEC)	TURBIDITY		TIME OF TEST (MIN)	NEEDLE PUNCH HOLE (MM)	FINAL HOLE	EFFLUENT
		SIDE	TOP				
40"	2.27	Clear	Clear	25 mins	1 mm	1 mm	distilled water

ESTABLISHED 1959

PERFORMANCE BY : J.G

REVIEWED BY : PST

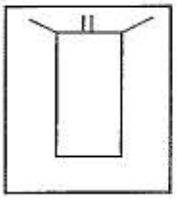
Associated Testing Laboratories, Inc
3143 Yellowstone Blvd
Houston, Texas 77054

ASSOCIATED TESTING LABORATORIES, INC
PINHOLE DISPERSION TEST DATA
ASTM D 4647, Method A

Project No. : G13-120
Boring No. : B-23
Sample Depth, ft : 6'-8'

Date Test: 3/5/2013
Operator: J.G

Water Content: 17
Curing Time: N/A
Effluent: Distilled Water
Compaction Characteristics: N/A



Specimen after test
Final Hole Diameter

1 mm

Flow Started on : 1 trial

Classification : ND 1

Clock Time	Head		Flow		Flow Rate, ml/sec	Turbidity from side					From Top	Remarks (reference to number of particles falling)
	in.	mm	ml	sec		Very Dark	Distinctly Dark	Very Slightly Dark	Barely Visible	Completely Clear	Completely Clear	
9:00	2"	50	10	17	0.59					√	√	No
9:02			10	17	0.59					√	√	No
9:03			10	16	0.63					√	√	No
9:04			10	16	0.63					√	√	No
9:05	2"	50	10	16	0.63					√	√	No
9:06			10	16	0.63					√	√	No
9:08			10	15	0.67					√	√	No
9:09			10	15	0.67					√	√	No
9:10	7"	180	10	10	1.00					√	√	No
9:11			10	10	1.00					√	√	No
9:13			25	25	1.00					√	√	No
9:14			25	25	1.00					√	√	No
9:15	15"	380	10	7	1.43					√	√	No
9:16			10	7	1.43					√	√	No
9:17			25	19	1.32					√	√	No
9:18			25	19	1.32					√	√	No
9:20	40"	1040	25	11	2.27					√	√	No
9:21			25	11	2.27					√	√	No
9:23			25	11	2.27					√	√	No
9:24			25	11	2.27					√	√	No

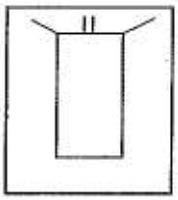
PERFORMANCE BY : J.G

REVIEWED BY : PST

Comments: Non Dispersive Soil

ASSOCIATED TESTING LABORATORIES, INC
PINHOLE DISPERSION TEST DATA
ASTM D 4647, Method A

Project No. :	G13-120	Date Test:	3/6/2013
Boring No. :	B-23	Operator:	J.G
Sample Depth, ft :	28'-30'		



Specimen after test
Final Hole Diameter

2.9 mm

Water Content:	23
Curing Time:	N/A
Effluent:	Distilled Water
Compaction Characteristics:	N/A
Flow Started on :	1 trial
Classification :	D 1

Clock Time	Head		Flow		Flow Rate, ml/sec	Turbidity from side					From Top	Remarks (reference to number of particles falling)
	in.	mm	ml	sec		Very Dark	Distinctly Dark	Very Slightly Dark	Barely Visible	Completely Clear	Ver Dark	
9:00	2"	50	10	5	2.00	√					√	Yes
9:01			10	5	2.00	√					√	Yes
9:02			25	12	2.08	√					√	Yes
9:04			25	12	2.08	√					√	Yes

PERFORMANCE BY : J.G *REVIEWED BY :* PST

Comments: Dispersive Soil

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

Original Wt. of the Soil : 57.42 Grams

Sieve Size Or Particle Size		Weight of soil Retained on Each Sieve	Percentage of Soil Retained on each Sieve	Percentage Passing
NO.10		0.00	0.00	100.00
NO.40		0.00	0.00	100.00
NO.200		5.78	10.07	89.93

Result of Laboratory Test (s)

Project No.	B-22
Sample Identification	
Depth (ft)	14'-16'
Date of Test	3/14/2013
Soil Description	Fat Clay (CH)

Sieve Size Or Particle Size	Percentage Passing
30.0000	100.00
25.5000	100.00
20.0000	100.00
12.5000	100.00
9.5000	100.00
4.7500	100.00
2.0000	100.00
0.4250	100.00
0.0750	89.93
0.0290	62.23
0.0189	54.63
0.0113	47.02
0.0081	44.26
0.0057	42.87
0.0028	41.49
0.0012	38.72

Associated Testing Laboratories , Inc.

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

Hydrometer Test

Hydrometer No #		*151- H*	*Project No #*	*G13-120*
Temperature In (F)			*Bore No #*	*B-22*
Temperature In (C)		*24.5*	*Depth*	*14'-16'*
Sp.gravity Of the Soil (Gs)		*2.7*	Weight of the Soil (gram)	57.42
Correction Factor (K)		*0.01275*	W	57.42

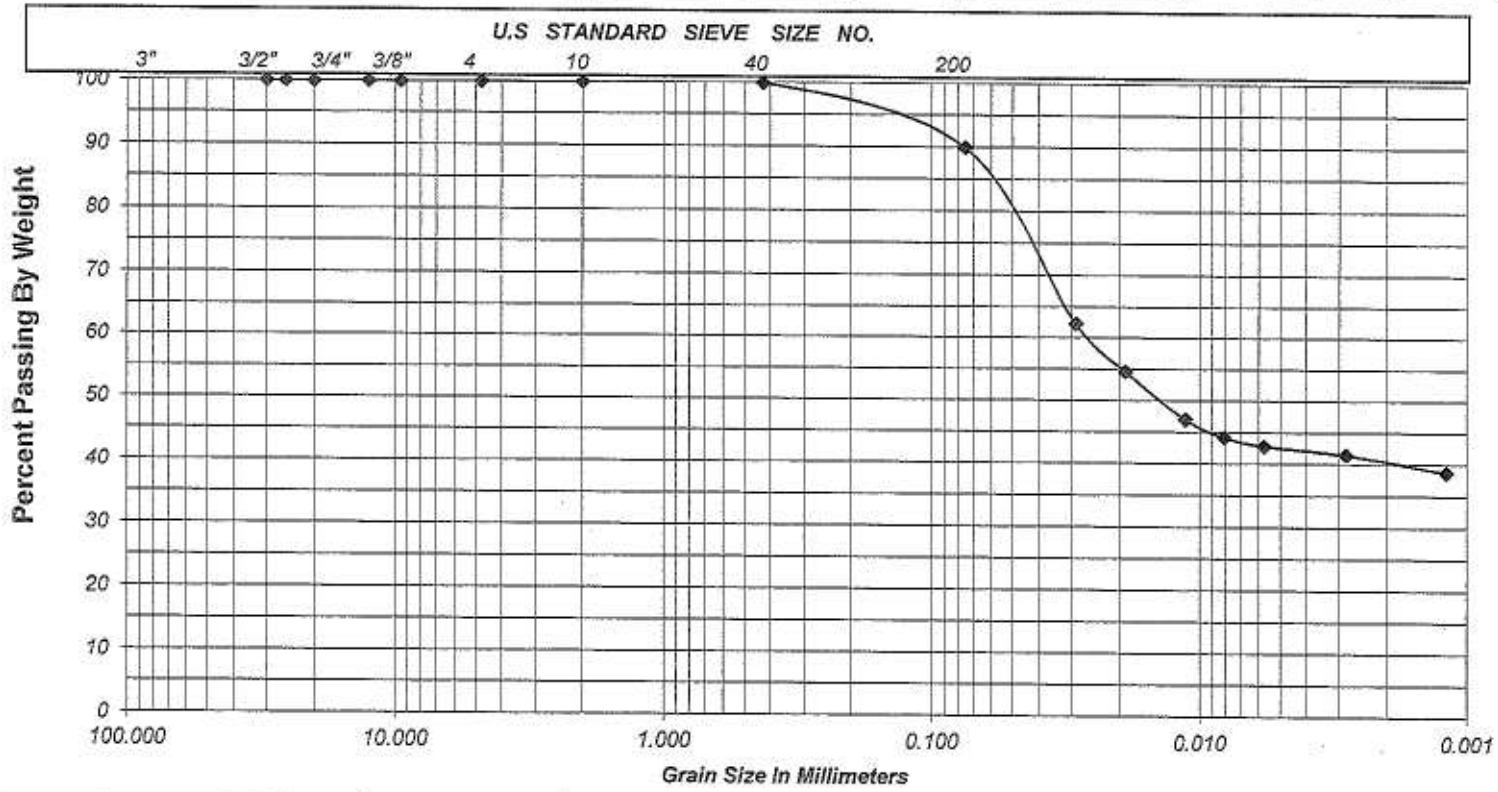
Time (T) Min	*Actual Hydrometer Reading*	*Hydrometer Reading After Correction factor*	*Effective Depth (L)*	*Particle Dia (mm)*	*% of Soil Remaining in Suspension (P)*
2	*1.0295*	*1.0225*	*10.35*	*0.0290*	*62.23*
5	*1.02675*	*1.01975*	*11.00*	*0.0189*	*54.63*
15	*1.024*	*1.017*	*11.80*	*0.0113*	*47.02*
30	*1.023*	*1.016*	*12.10*	*0.0081*	*44.26*
60	*1.0215*	*1.0155*	*12.20*	*0.0057*	*42.87*
250	*1.02*	*1.015*	*12.30*	*0.0028*	*41.49*
1440	*1.019*	*1.014*	*12.60*	*0.0012*	*38.72*

Associated Testing Laboratories, Inc

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

Associated Testing Laboratories Inc.

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	



Project	Boring	Depth	Symbol	Classification
G13-120	B-22	14'-16'	CH	Fat Clay (CH)

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

Original Wt. of the Soil : 67.82 Grams

Sieve Size Or Particle Size		Weight of soil Retained on Each Sieve	Percentage of Soil Retained on each Sieve	Percentage Passing
NO.10		0.00	0.00	100.00
NO.40		0.01	0.01	99.99
NO.200		0.14	0.21	99.78

Result of Laboratory Test (s)

Project No.	B-23
Sample Identification	
Depth (ft)	28'-30'
Date of Test	3/14/2013
Soil Description	Lean Clay (CL)

Sieve Size Or Particle Size	Percentage Passing
30.0000	100.00
25.5000	100.00
20.0000	100.00
12.5000	100.00
9.5000	100.00
4.7500	100.00
2.0000	100.00
0.4250	99.99
0.0750	99.78
0.0269	65.57
0.0187	50.35
0.0113	39.81
0.0083	32.79
0.0060	28.10
0.0030	23.42
0.0013	19.91

Associated Testing Laboratories , Inc.

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

Hydrometer Test

Hydrometer No #		*151- H*	*Project No #*	*G13-120*
Temperature In (F)			*Bore No #*	*B-23*
Temperature In (C)		*24.5*	*Depth*	*28'-30'*
Sp.gravity Of the Soil (Gs)		*2.7*	Weight of the Soil (gram)	67.82
Correction Factor (K)		*0.01275*	W	67.82

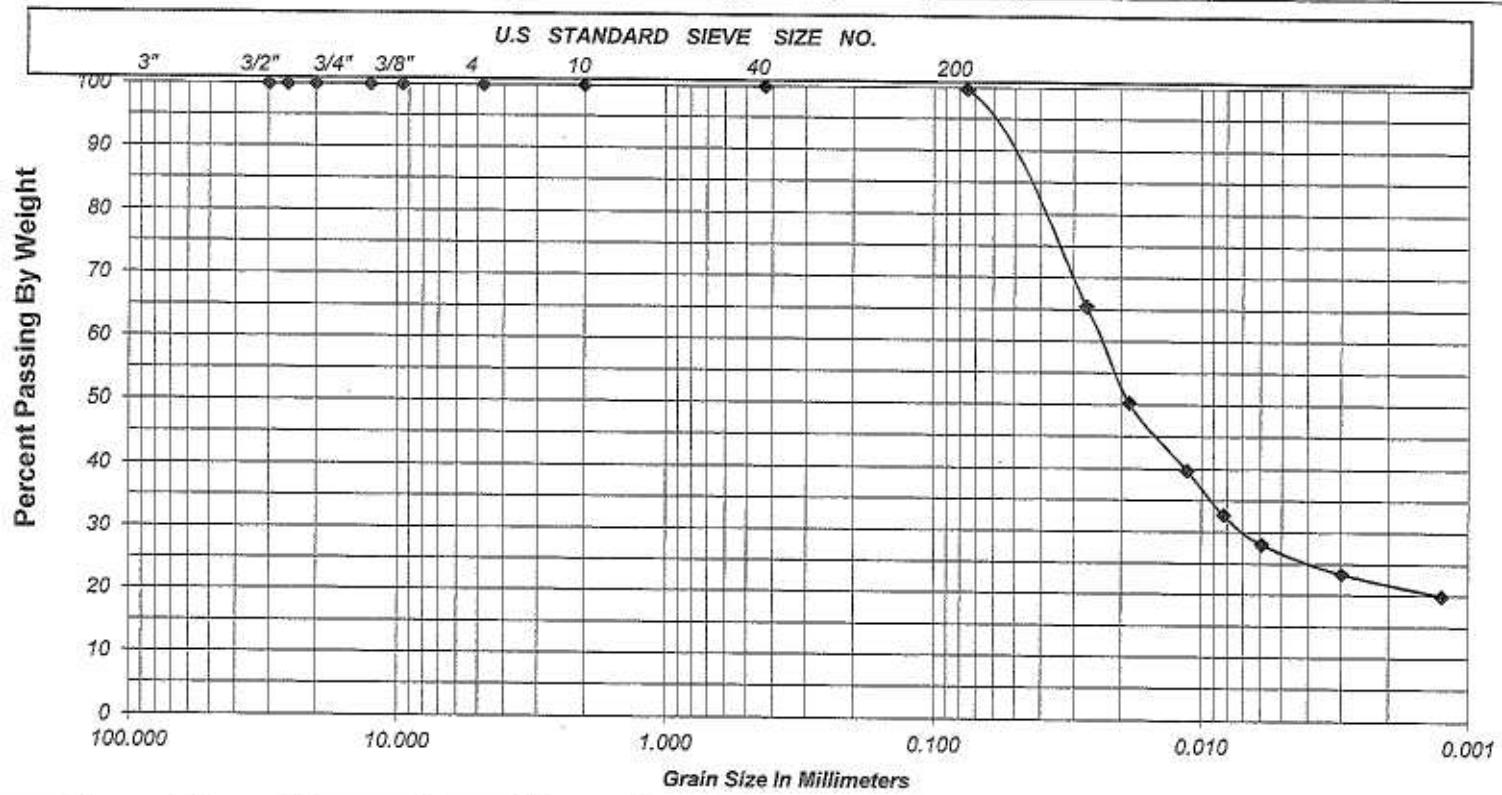
Time (T) Min	*Actual Hydrometer Reading*	*Hydrometer Reading After Correction factor*	*Effective Depth (L)*	*Particle Dia (mm)*	*% of Soil Remaining in Suspension (P)*
2	*1.035*	*1.028*	*8.90*	*0.0269*	*65.57*
5	*1.0285*	*1.0215*	*10.70*	*0.0187*	*50.35*
15	*1.024*	*1.017*	*11.80*	*0.0113*	*39.81*
30	*1.021*	*1.014*	*12.60*	*0.0083*	*32.79*
60	*1.019*	*1.012*	*13.10*	*0.0060*	*28.10*
250	*1.015*	*1.01*	*13.70*	*0.0030*	*23.42*
1440	*1.0135*	*1.0085*	*14.05*	*0.0013*	*19.91*

Associated Testing Laboratories, Inc

Standard Test Method for Particle-Size Analysis of Soils
ASTM D 422

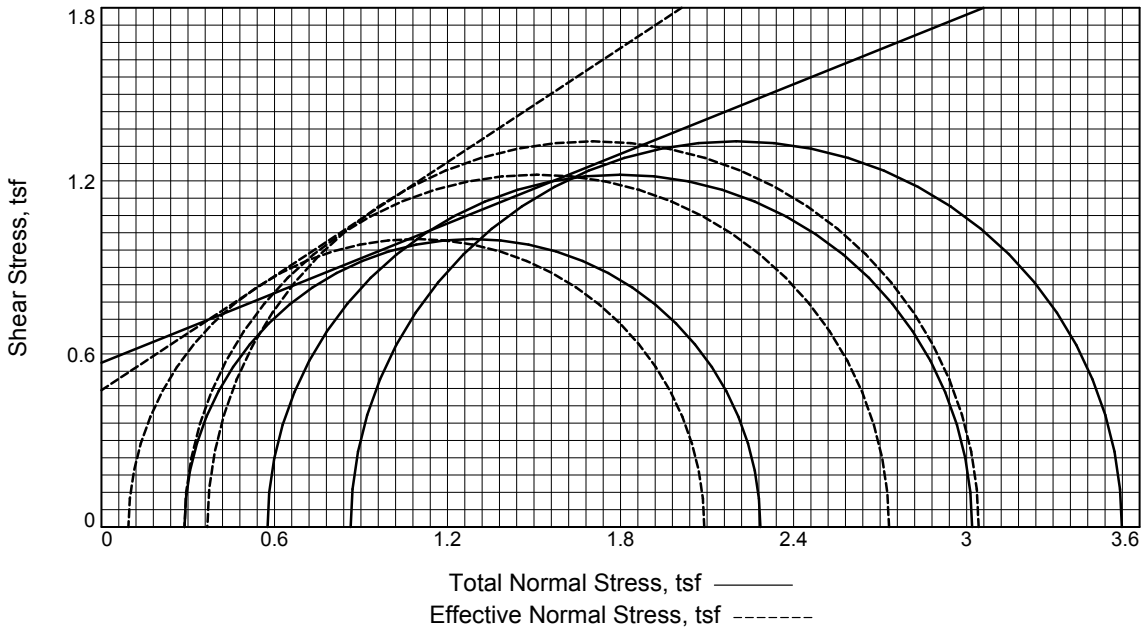
Associated Testing Laboratories Inc.

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	



Project	Boring	Depth	Symbol	Classification
G13-120	B-23	28'-30'	CL	Lean Clay (CL)

TRIAXIAL SHEAR TEST REPORT



Type of Test: CU with Pore Pressures **Sample Type:** Undistured

No.	Fluid Press. psi		Fail. Stress, tsf		Ult. Stress, tsf		Principal Stresses at Failure tsf	
	Cell	Back	Deviator	Excess Pore Pressure	Deviator	Excess Pore Pressure	$\bar{\sigma}_1$	$\bar{\sigma}_3$
1	54.00	50.00	1.997	0.194	1.997	0.194	2.090	0.094
2	58.00	50.00	2.443	0.288	2.443	0.288	2.731	0.288
3	62.00	50.00	2.675	0.497	2.675	0.497	3.042	0.367

No.	Consolidated Sample Parameters						
	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in.	Height in.	% Strain at Peak
1	15.5	118.8	100.0%	0.4191	2.76	5.79	4.6
2	18.3	112.8	100.0%	0.4948	2.80	5.78	4.6
3	15.7	118.5	100.0%	0.4226	2.81	5.75	2.9

Mohr-Coulomb Strength Parameters	Total	Effective
Strength intercept, c=	0.569 tsf	0.474 tsf
Friction angle, ϕ =	21.9 deg	33.4 deg
Tangent, ϕ =	0.40	0.66

Material Description

Sandy Clay (CL)

Client: Cobb, Findly & Associates, Inc

Project: Water Line Replacement in Inner Loop North Area, Houston,TX

Location: B-22

Sample Number: 1 **Depth:** 4-6,8-10,10-12

Date Sampled: 03/25/2013

File: G13-120 CU

Remarks:

Sample bulged at failured

TRIAXIAL SHEAR TEST REPORT

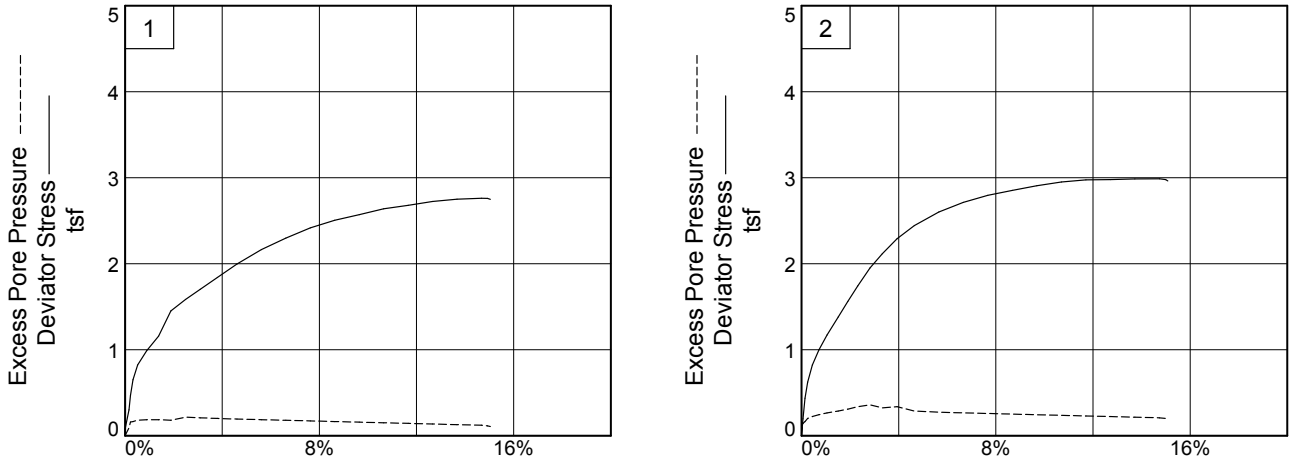
Stork Southwestern Laboratories, Inc.

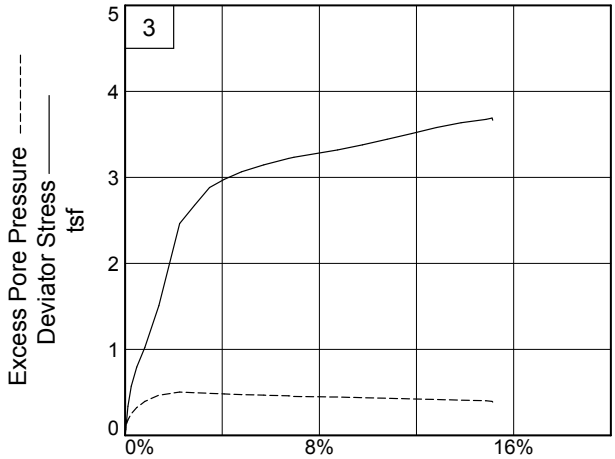
Beaumont, TX

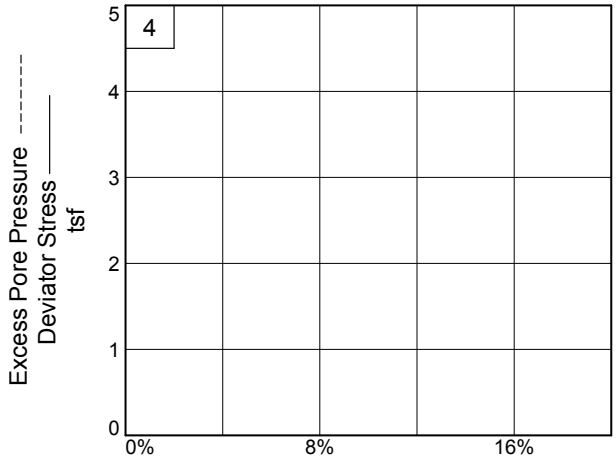
Proj. No.: G13-120

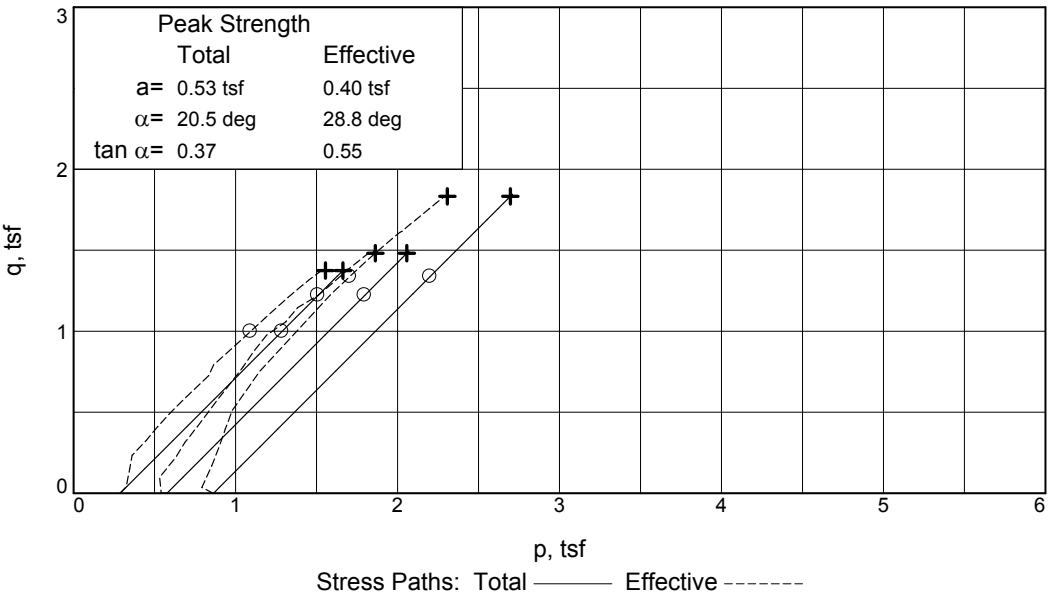
Figure a

Tested By: J.G (375) **Checked By:** PST









Client: Cobb, Findly & Associates, Inc

Project: Water Line Replacement in Inner Loop North Area, Houston,TX

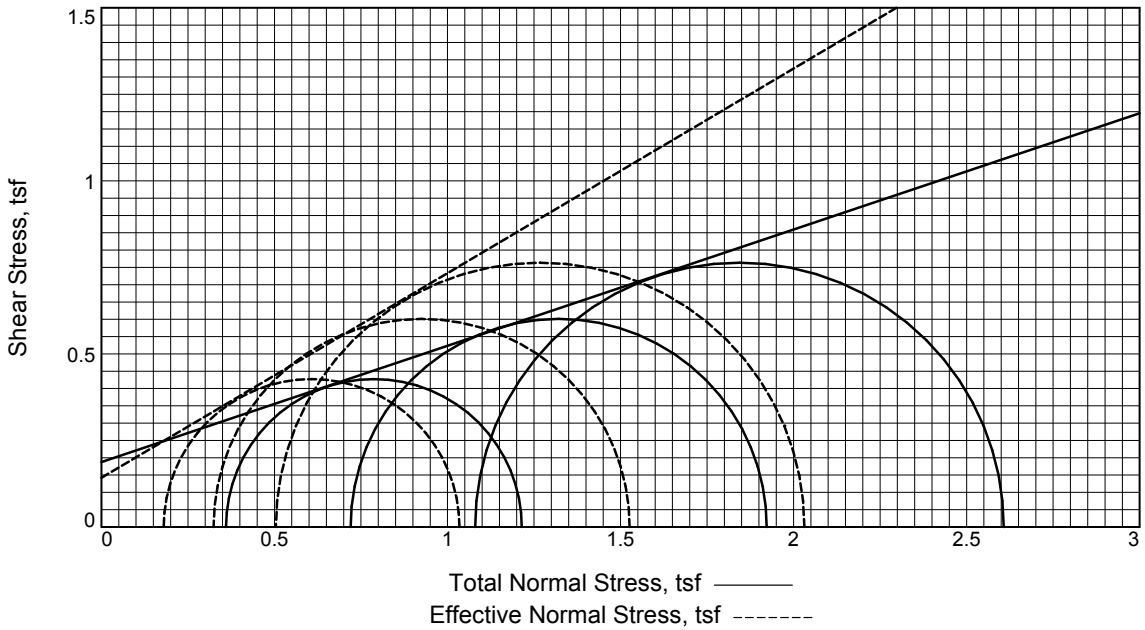
Location: B-22 **Depth:** 4-6,8-10,10-12 **Sample Number:** 1

Project No.: G13-120 **Figure** b

Stork Southwestern Laboratories, Inc.

Tested By: J.G (375) **Checked By:** PST

TRIAXIAL SHEAR TEST REPORT



Type of Test: CU with Pore Pressures **Sample Type:** Undistured

No.	Fluid Press. psi		Fail. Stress, tsf		Ult. Stress, tsf		Principal Stresses at Failure tsf	
	Cell	Back	Deviator	Excess Pore Pressure	Deviator	Excess Pore Pressure	$\bar{\sigma}_1$	$\bar{\sigma}_3$
1	55.00	50.00	0.854	0.180	0.854	0.180	1.034	0.180
2	60.00	50.00	1.202	0.396	1.202	0.396	1.526	0.324
3	65.00	50.00	1.527	0.576	1.527	0.576	2.031	0.504

No.	Consolidated Sample Parameters						
	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in.	Height in.	% Strain at Peak
1	18.8	111.8	100.0%	0.5078	2.79	5.76	1.9
2	21.3	107.1	100.0%	0.5740	2.72	5.74	3.0
3	25.9	99.2	100.0%	0.6990	2.78	5.73	2.6

Mohr-Coulomb Strength Parameters	Total	Effective
Strength intercept, c=	0.188 tsf	0.142 tsf
Friction angle, ϕ =	18.6 deg	30.6 deg
Tangent, ϕ =	0.34	0.59

Material Description

Sandy Clay

Client: Cobb, Findly & Associates, Inc

Project: Water Line Replacement in Inner Loop North Area, Houston,TX

Location: B-23

Sample Number: 2 **Depth:** 4-6,10-12,14-16

Date Sampled: 03/25/2013

File: G13-120 CU

Remarks:

Sample bulged at failured

TRIAXIAL SHEAR TEST REPORT

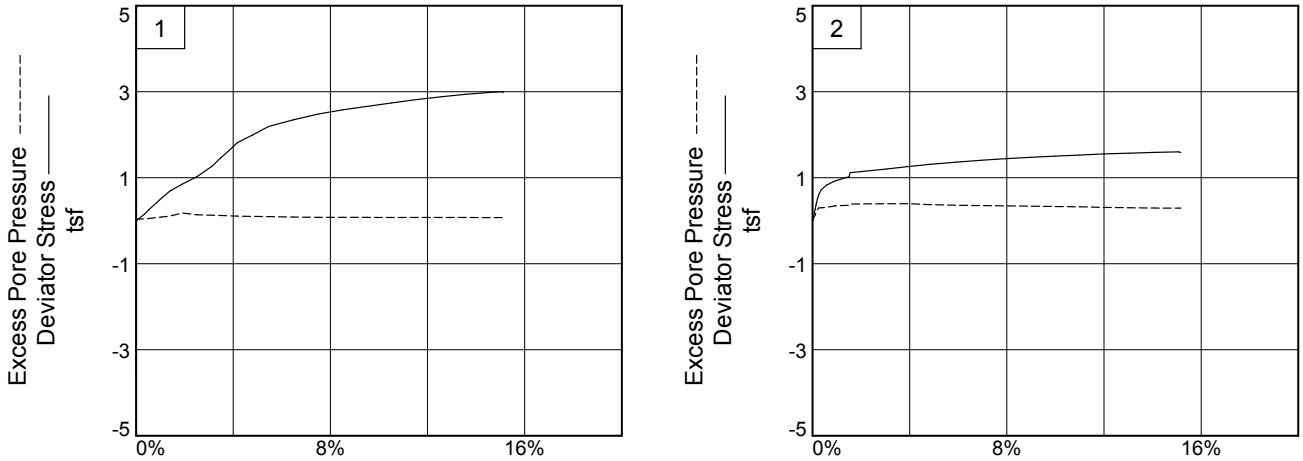
Stork Southwestern Laboratories, Inc.

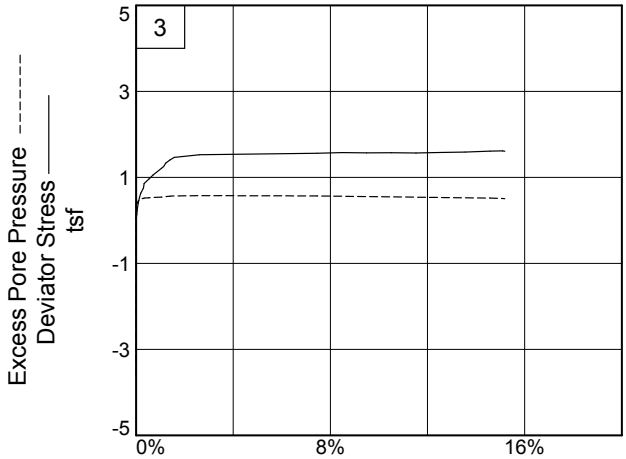
Beaumont, TX

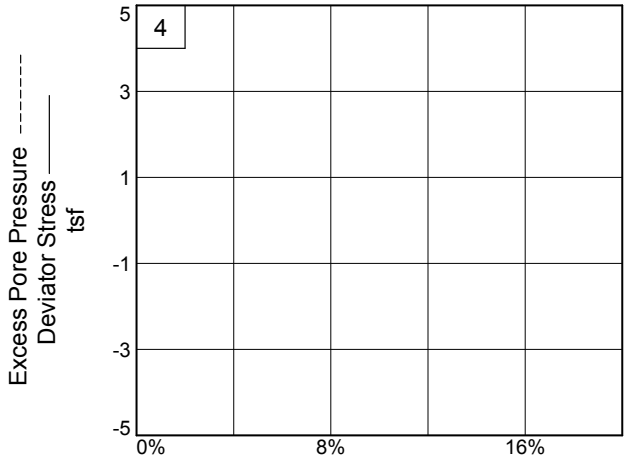
Proj. No.: G13-120

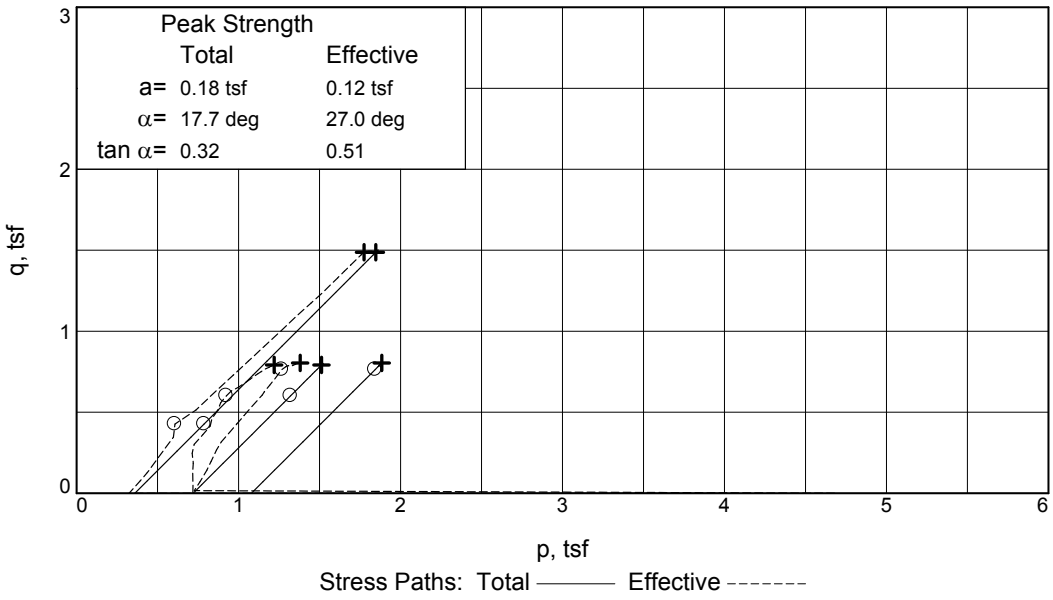
Figure a

Tested By: J.G (375) **Checked By:** PST









Client: Cobb, Findly & Associates, Inc

Project: Water Line Replacement in Inner Loop North Area, Houston,TX

Location: B-23 **Depth:** 4-6,10-12,14-16 **Sample Number:** 2

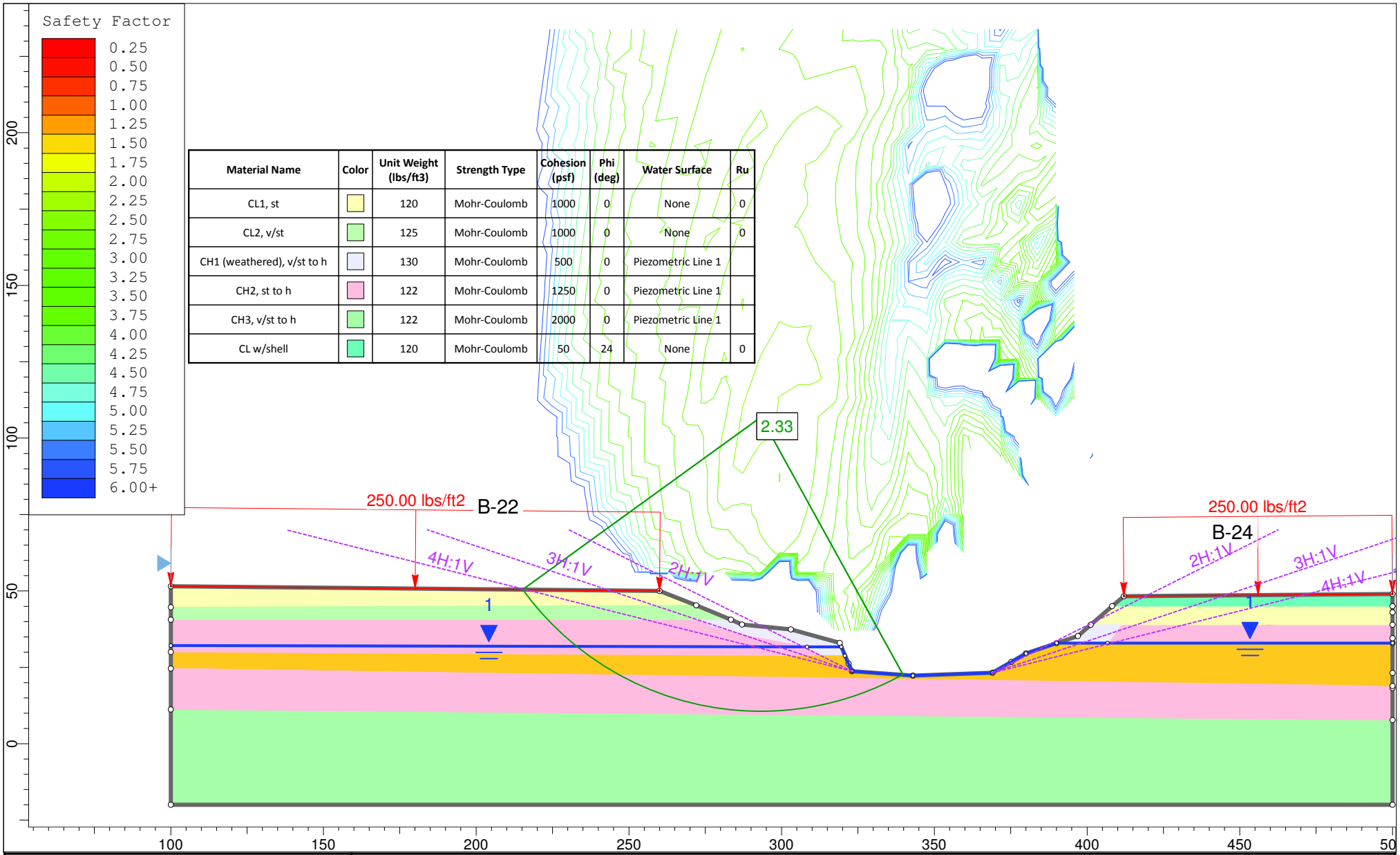
Project No.: G13-120 **Figure** b

Stork Southwestern Laboratories, Inc.

Tested By: J.G (375) **Checked By:** PST

APPENDIX 5

RESULTS OF SLOPE STABILITY ANALYSES AT LITTLE WHITE OAK BAYOU CROSSINGS (LINK ROAD AND ENID STREET)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	1000	0	None	0
CL2, v/st		125	Mohr-Coulomb	1000	0	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	500	0	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	1250	0	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	2000	0	Piezometric Line 1	
CL w/shell		120	Mohr-Coulomb	50	24	None	0

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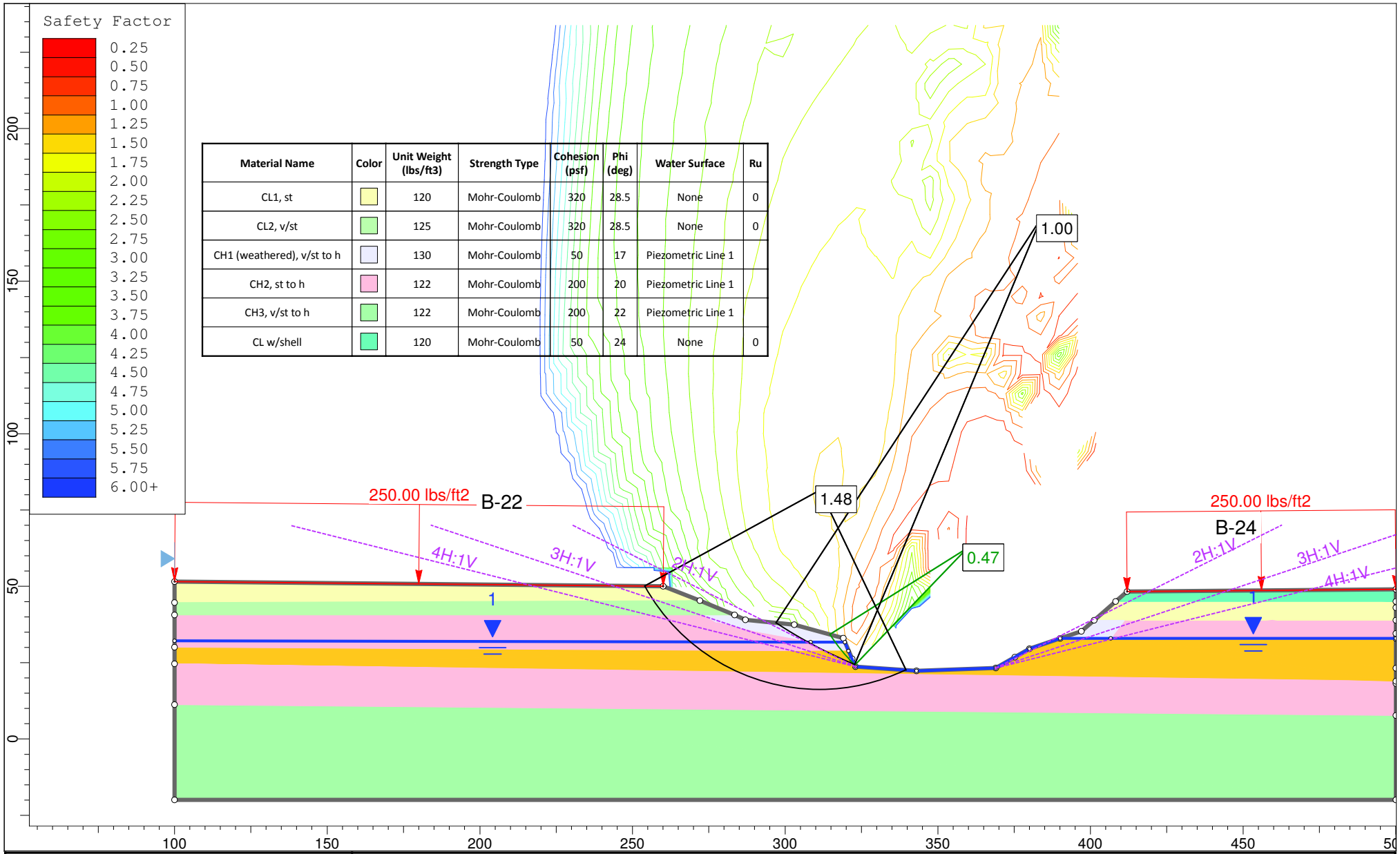
SLIDEINTERPRET 6.022

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Short Term Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:521	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_ST_B22B24_LtSlope.slim

FIGURE 5-1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	
CL w/shell		120	Mohr-Coulomb	50	24	None	0

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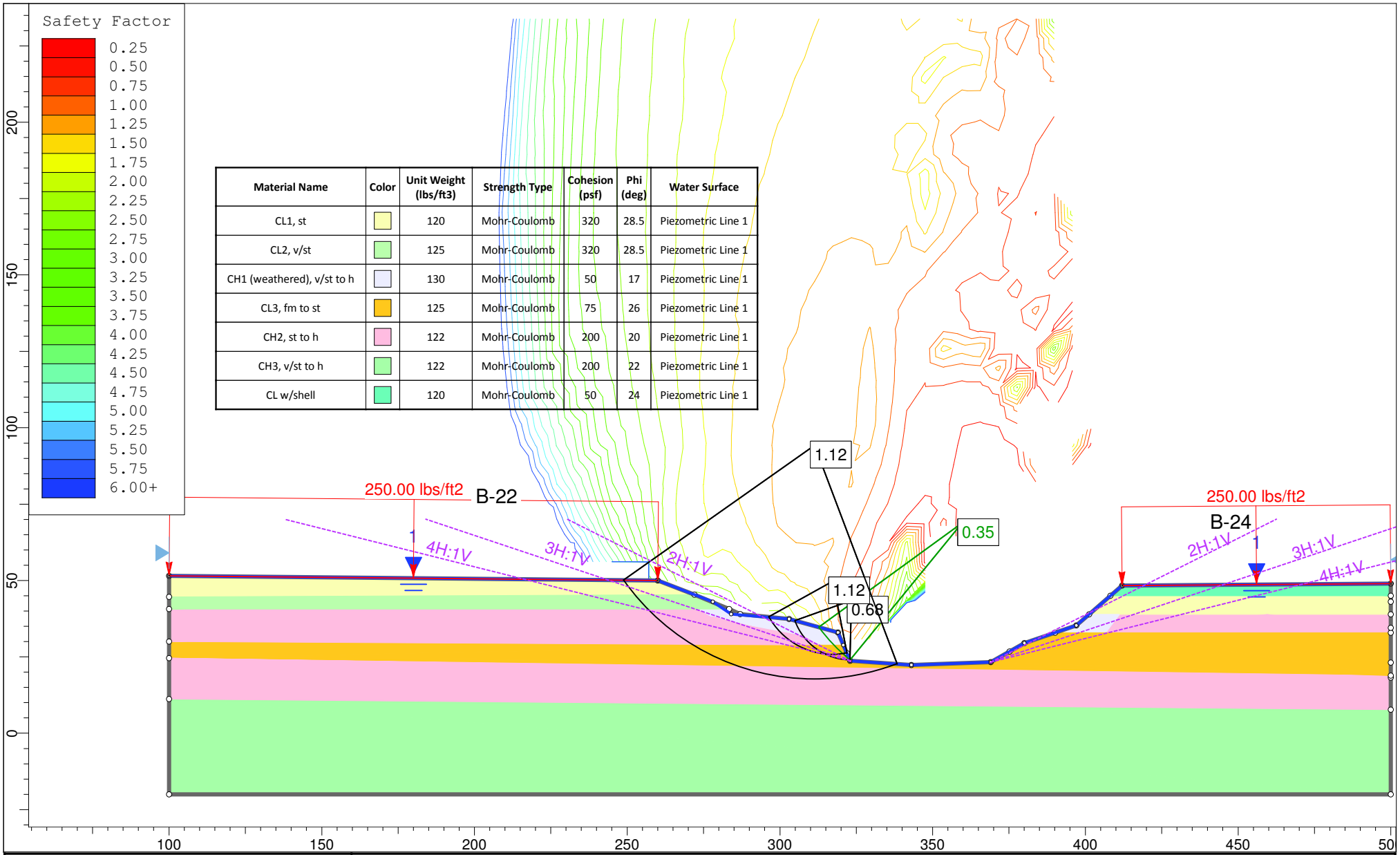
SLIDEINTERPRET 6.022

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Long Term Condition (B-22 and B-24)		
Drawn By PST	*Scale* 1:521	*Company* ATL	
Date 5/13/2013		*File Name* G13-120_Bayou at Link Rd_LT_B22B24_LtSlope.slim	

FIGURE 5-2

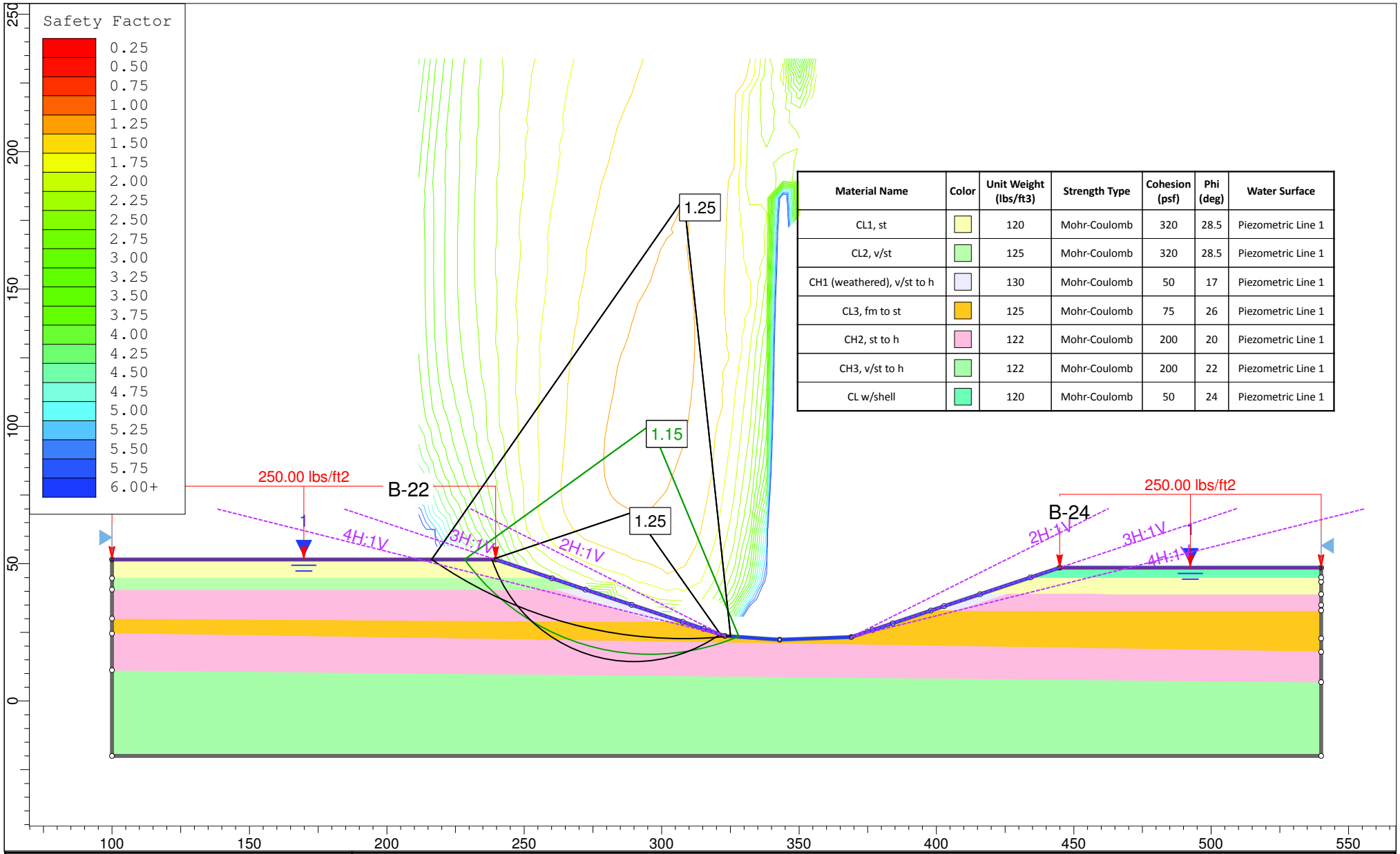


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By PST	*Scale* 1:521	*Company* ATL	
Date 5/13/2013		*File Name* G13-120_Bayou at Link Rd_RD_B22B24_LtoR.slim	

SLIDEINTERPRET 6.022

FIGURE 5-3

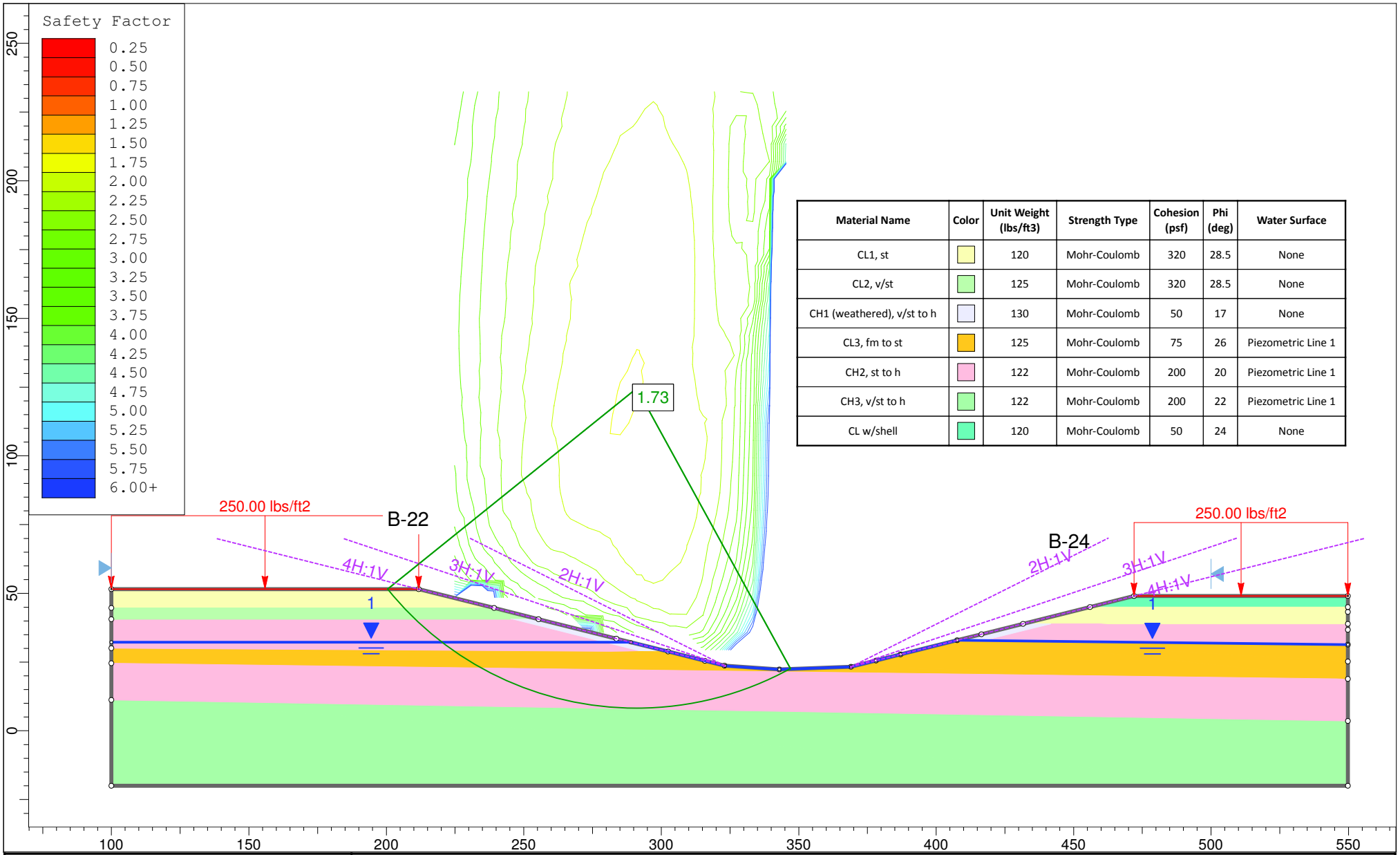


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:579	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_RD_B22B24_3H1V_LtoR.slim

SLIDEINTERPRET 6.022

FIGURE 5-4



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	None
CL2, v/st		125	Mohr-Coulomb	320	28.5	None
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	None
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	None

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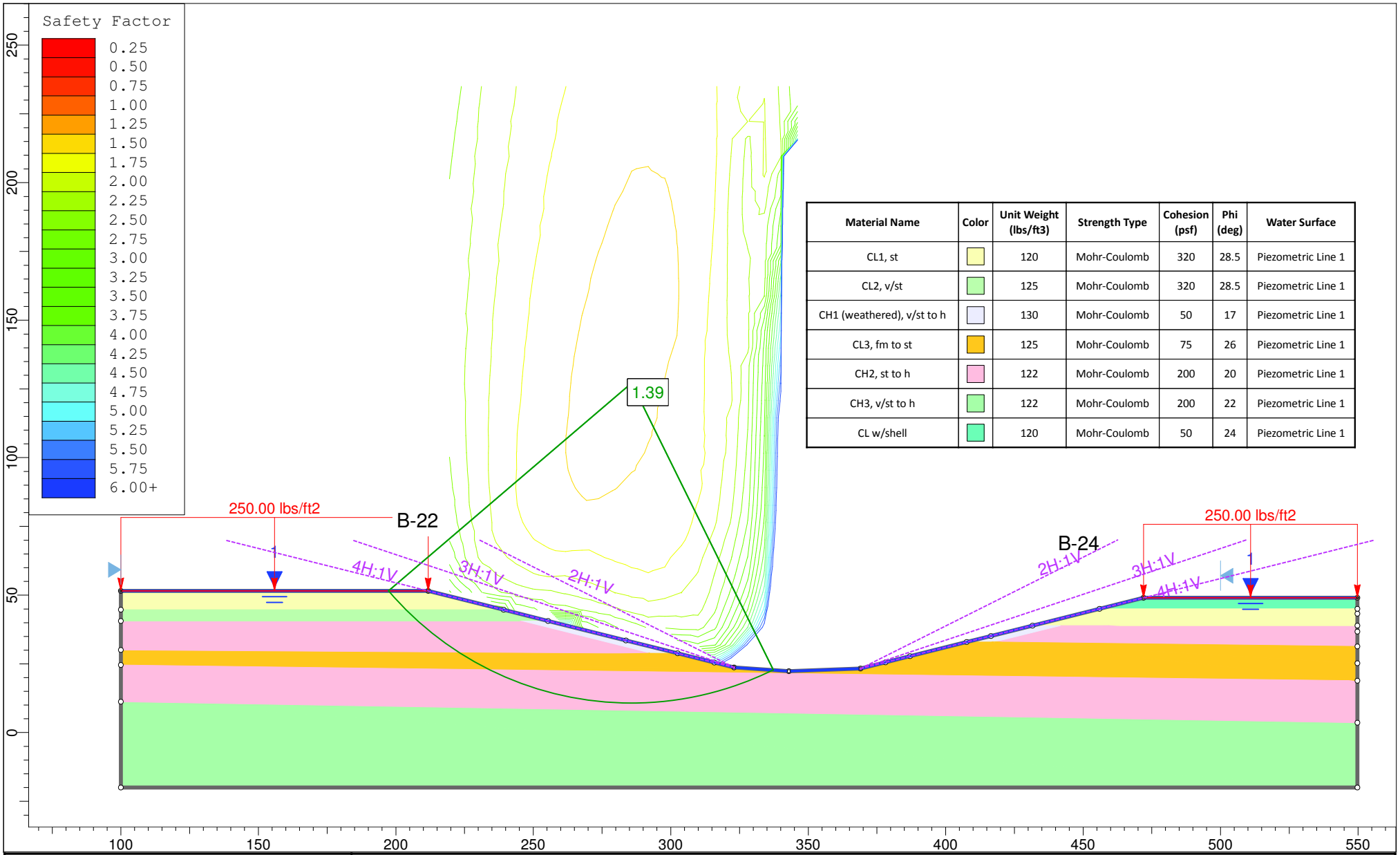
SLIDEINTERPRET 6.022

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Long Term Condition (B-22 and B-24)		
Drawn By PST	*Scale* 1:579	*Company* ATL	
Date 5/13/2013		*File Name* G13-120_Bayou at Link Rd_LT_B22B24_4H1V_LtoR.slim	

FIGURE 5-5

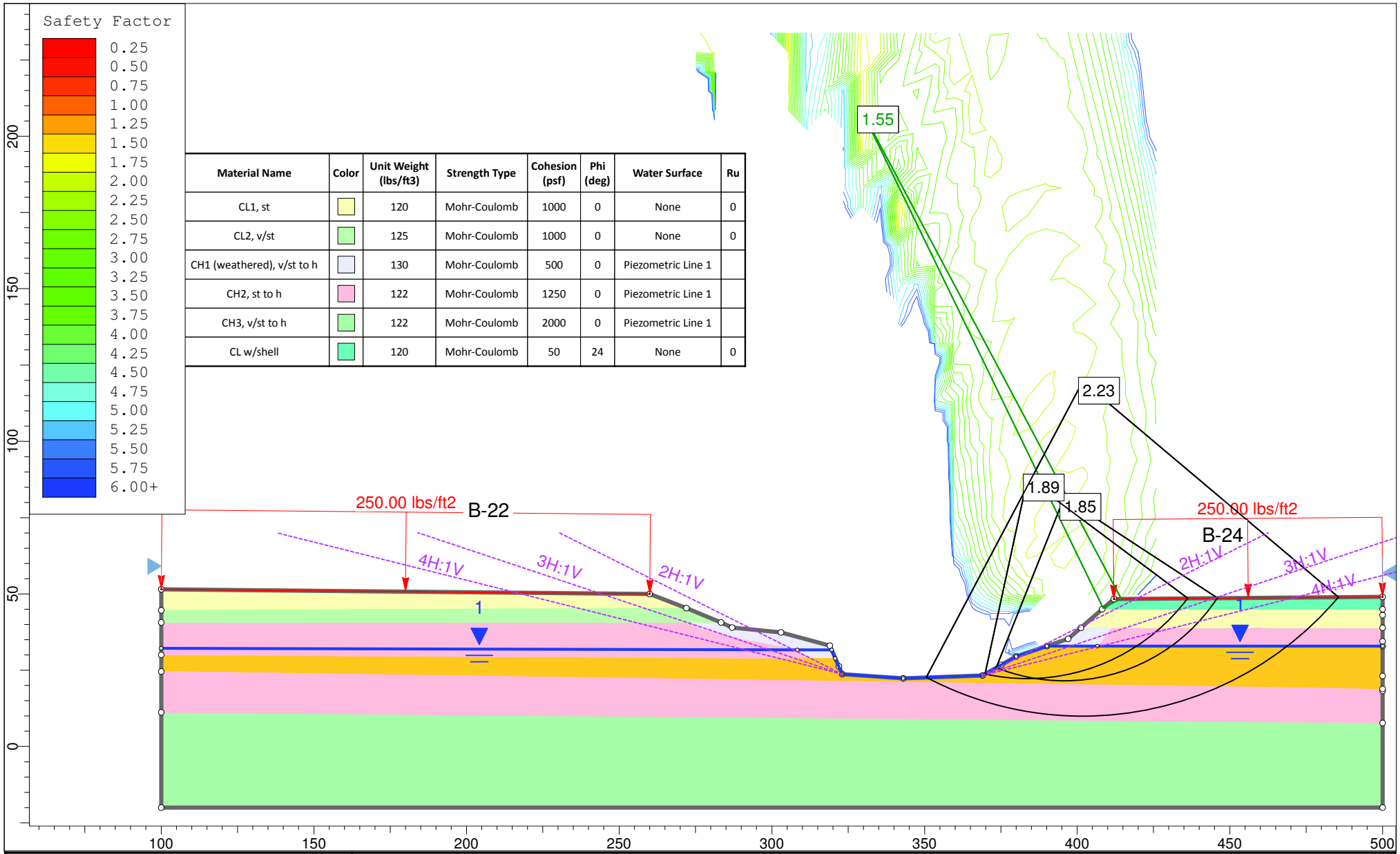


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:579	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_RD_B22B24_4H1V_LtoR.slim

SLIDEINTERPRET 6.022

FIGURE 5-6

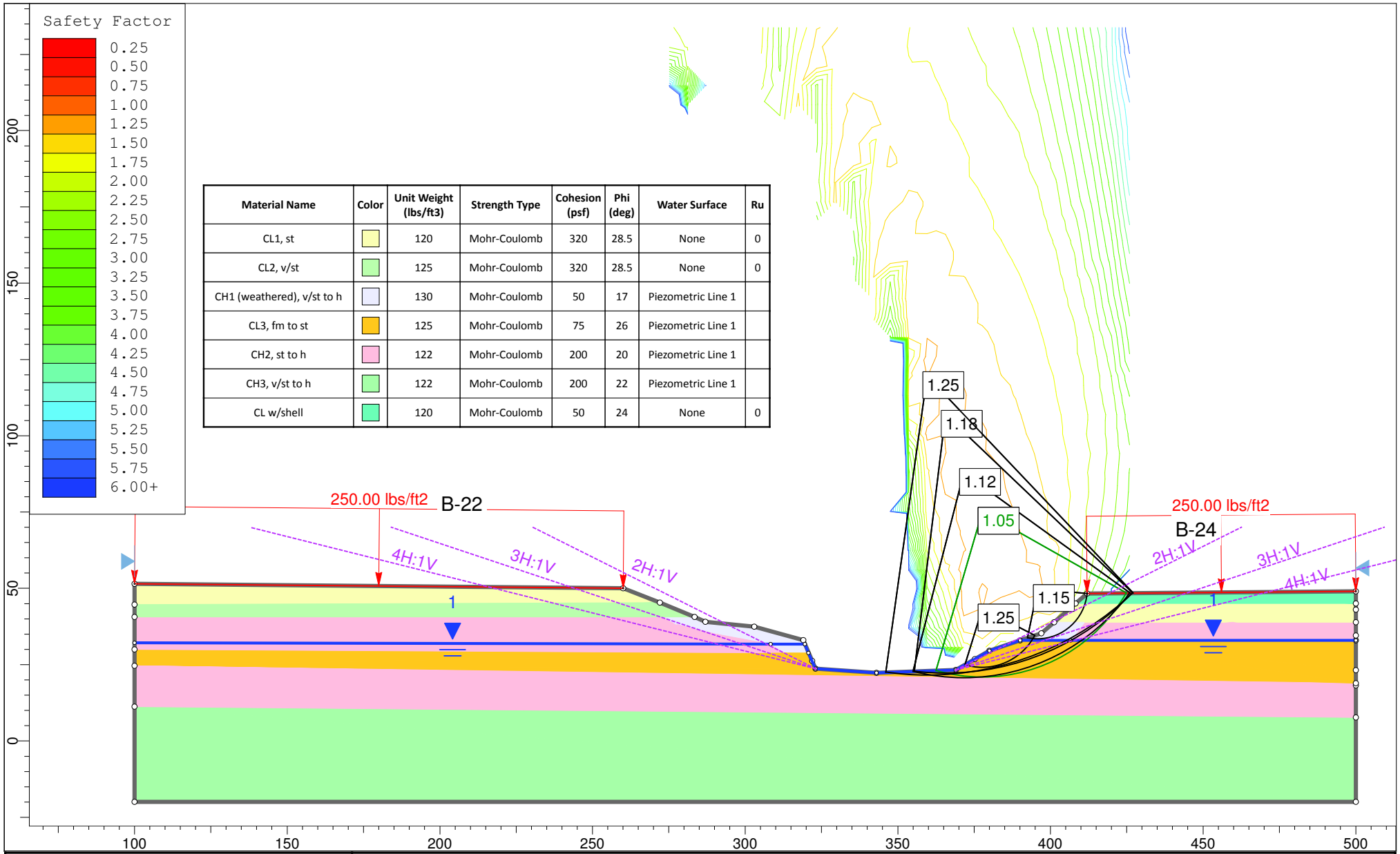


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	1000	0	None	0
CL2, v/st		125	Mohr-Coulomb	1000	0	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	500	0	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	1250	0	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	2000	0	Piezometric Line 1	
CL w/shell		120	Mohr-Coulomb	50	24	None	0

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Short Term Condition (B-22 and B-24)		
Drawn By: PST	Scale: 1:521	Company: ATL	
Date: 5/13/2013		File Name: G13-120_Bayou at Link Rd_ST_B22B24_RtSlope.slim	

SLIDEINTERPRET 6.022

FIGURE 5-7

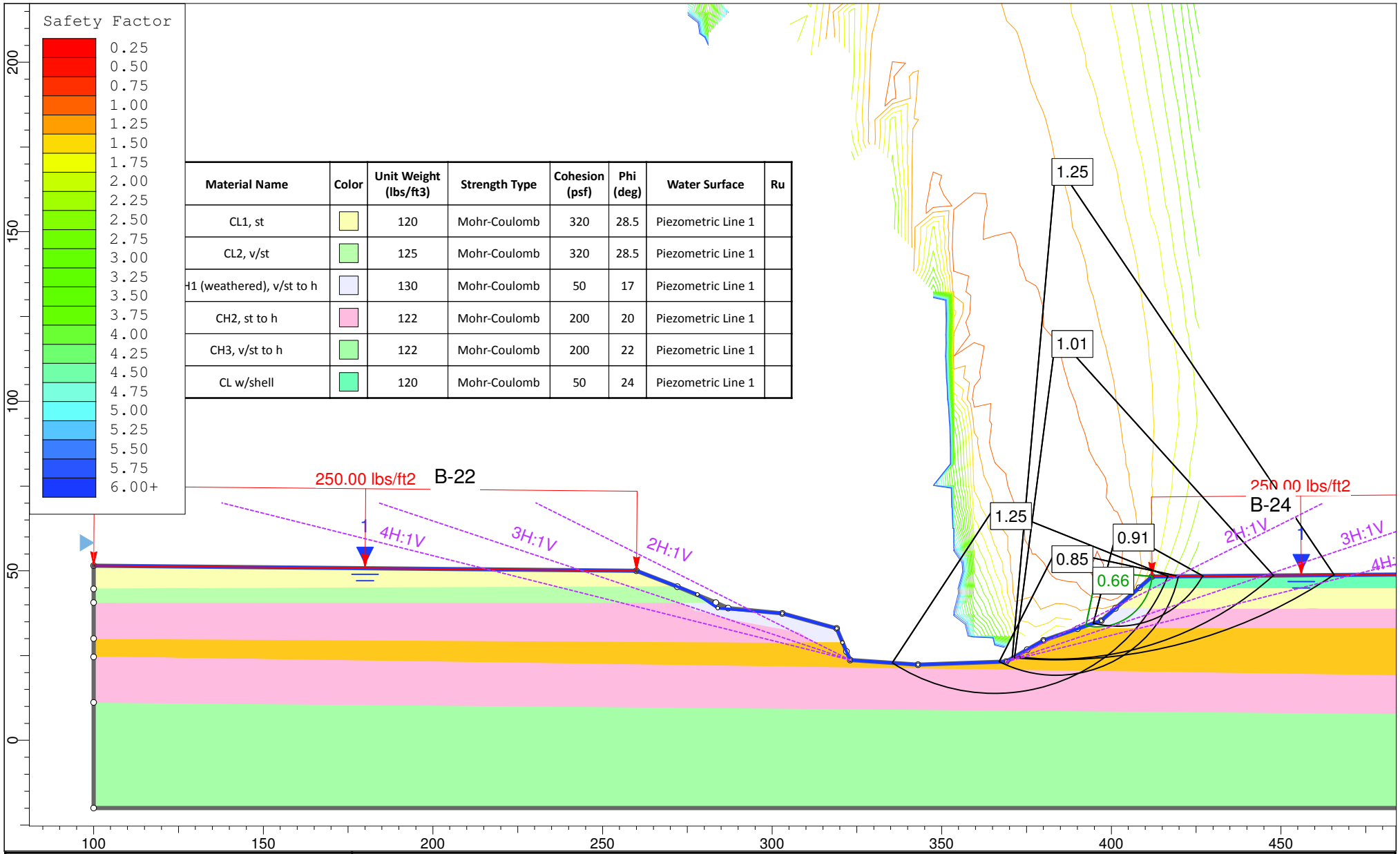


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	
CL w/shell		120	Mohr-Coulomb	50	24	None	0

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Long Term Condition (B-22 and B-24)		
Drawn By: PST	Scale: 1:521	Company: ATL	
Date: 5/13/2013		File Name: G13-120_Bayou at Link Rd_LT_B22B24_RtSlope.slim	

SLIDEINTERPRET 6.022

FIGURE 5-8

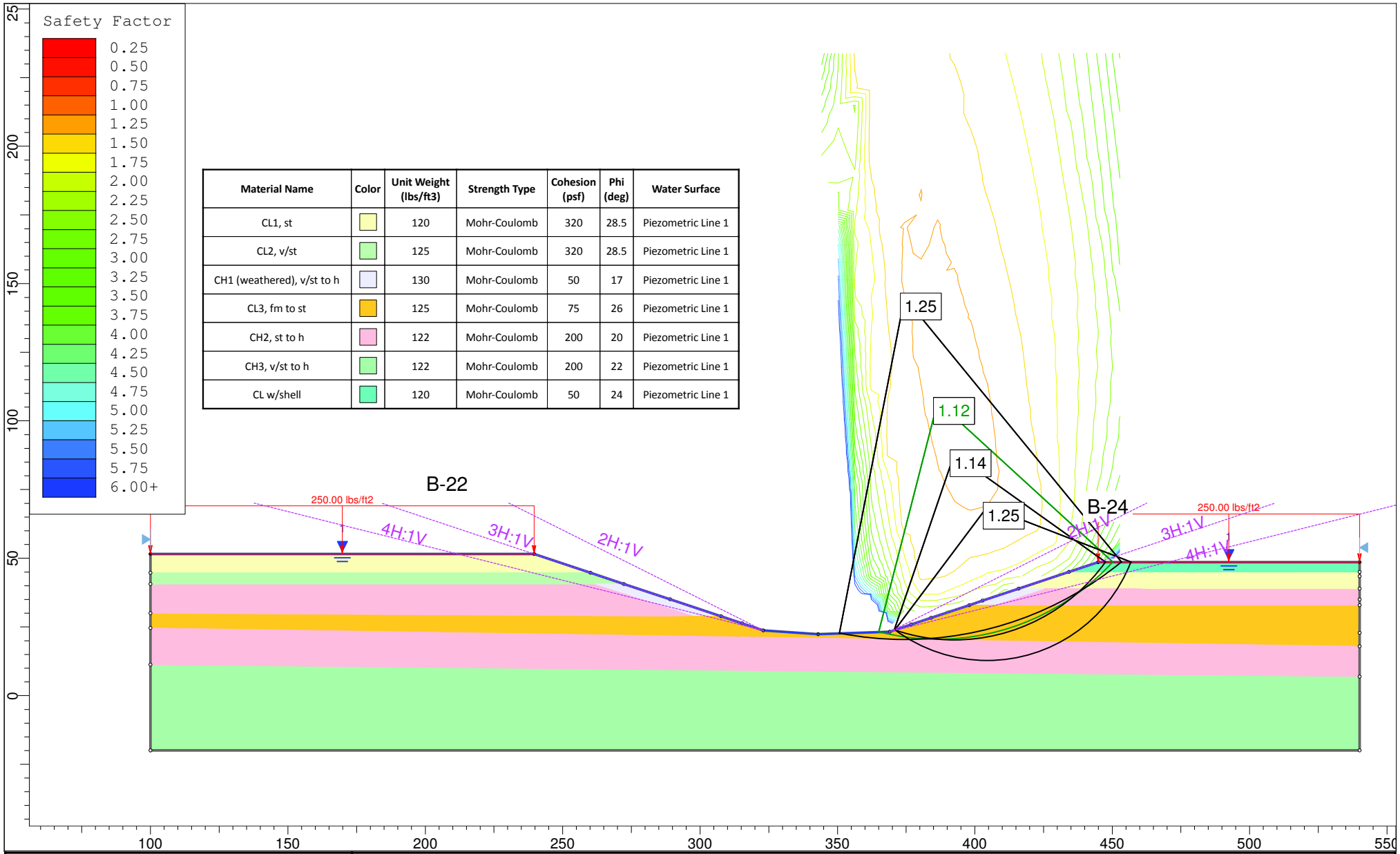


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
H1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:469	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_RD_B22B24_RtoL.slim

SLIDEINTERPRET 6.022

FIGURE 5-9

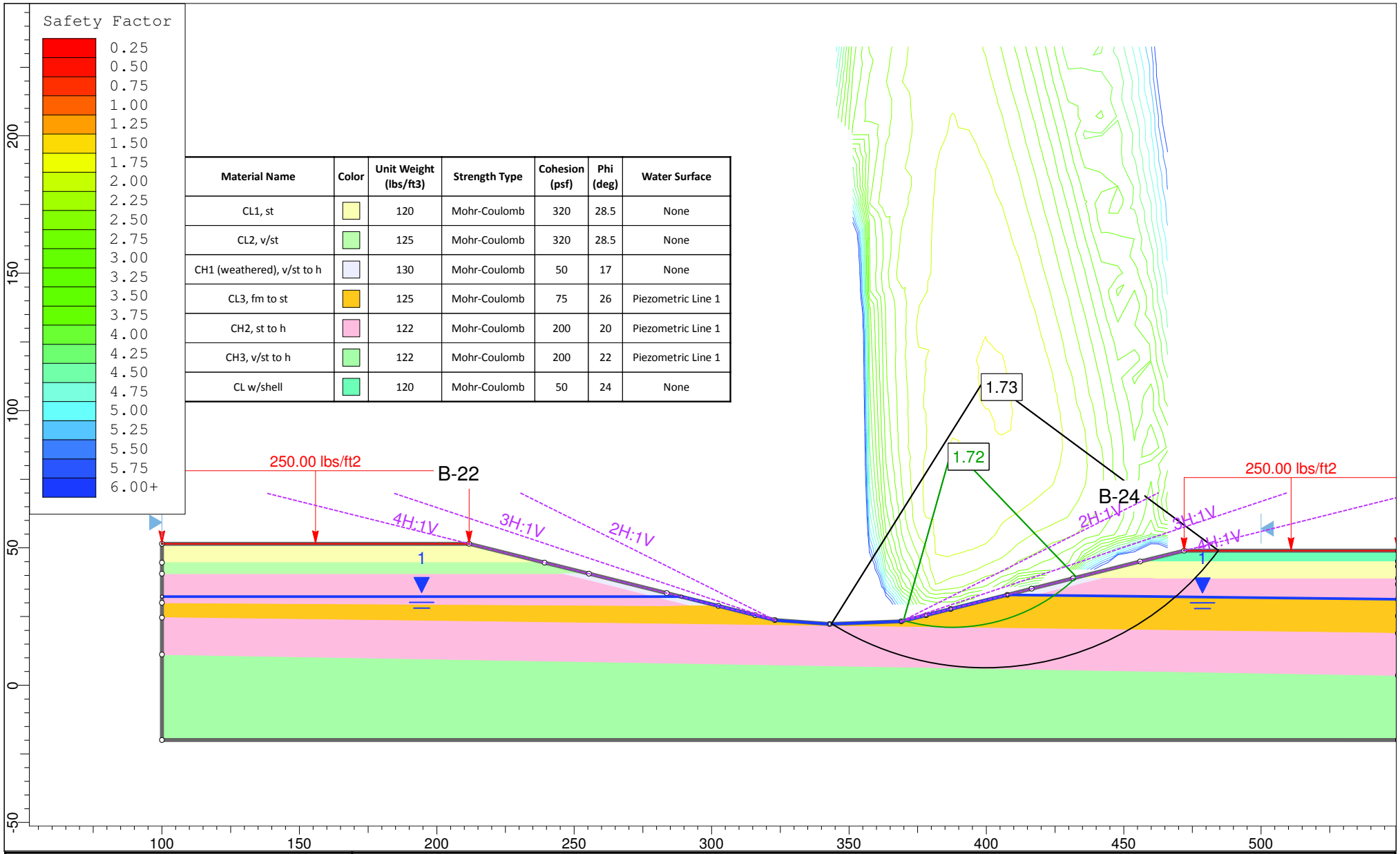


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:579	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_RD_B22B24_3H1V_RtoL.slim

SLIDEINTERPRET 6.022

FIGURE 5-10

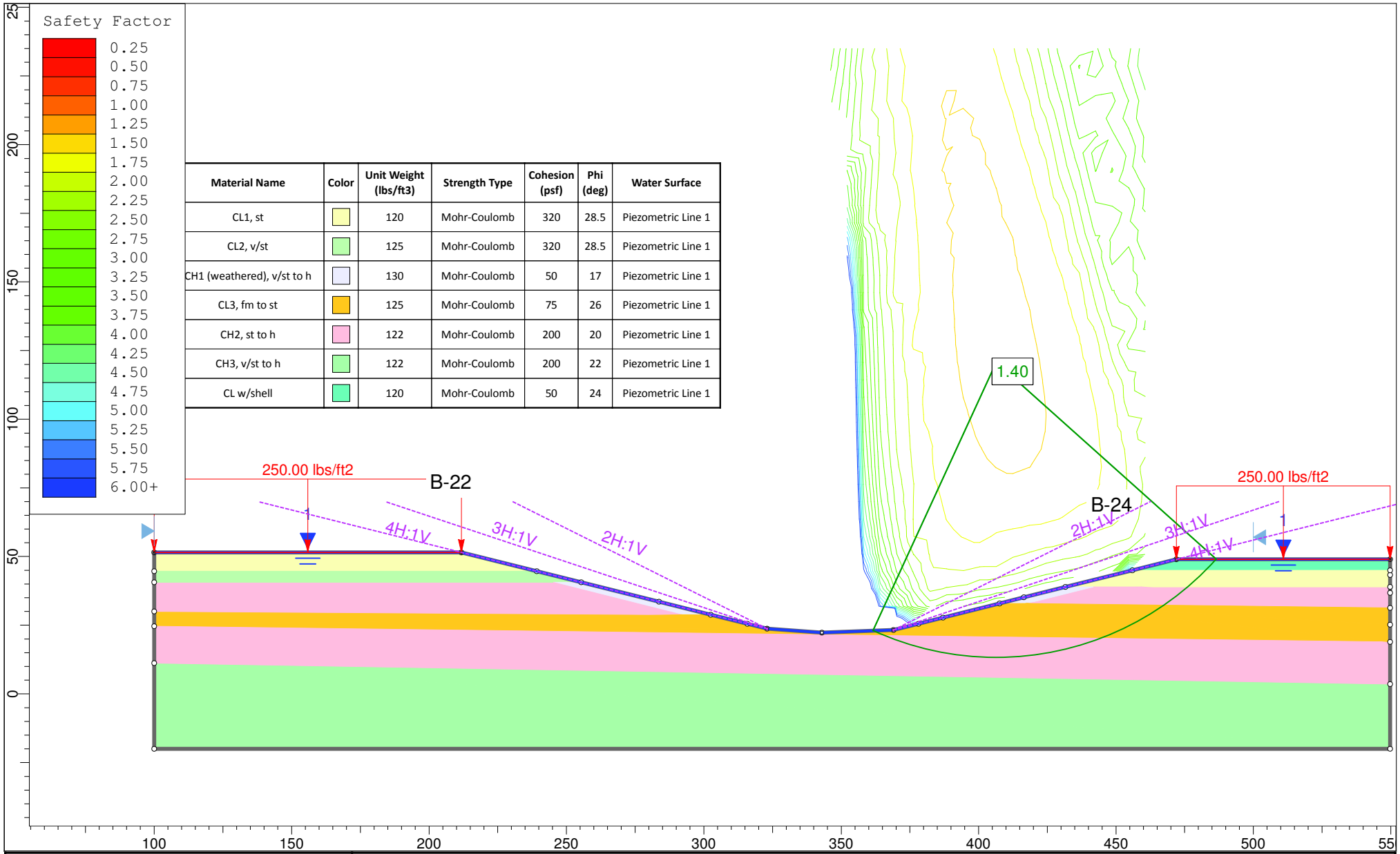


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	None
CL2, v/st		125	Mohr-Coulomb	320	28.5	None
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	None
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	None

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd_Long Term Condition (B-22 and B-24)		
Drawn By	PST	Scale 1:579	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Link Rd_LT_B22B24_4H1V_RtoL.slim

SLIDEINTERPRET 6.022

FIGURE 5-11



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1
CL w/shell		120	Mohr-Coulomb	50	24	Piezometric Line 1

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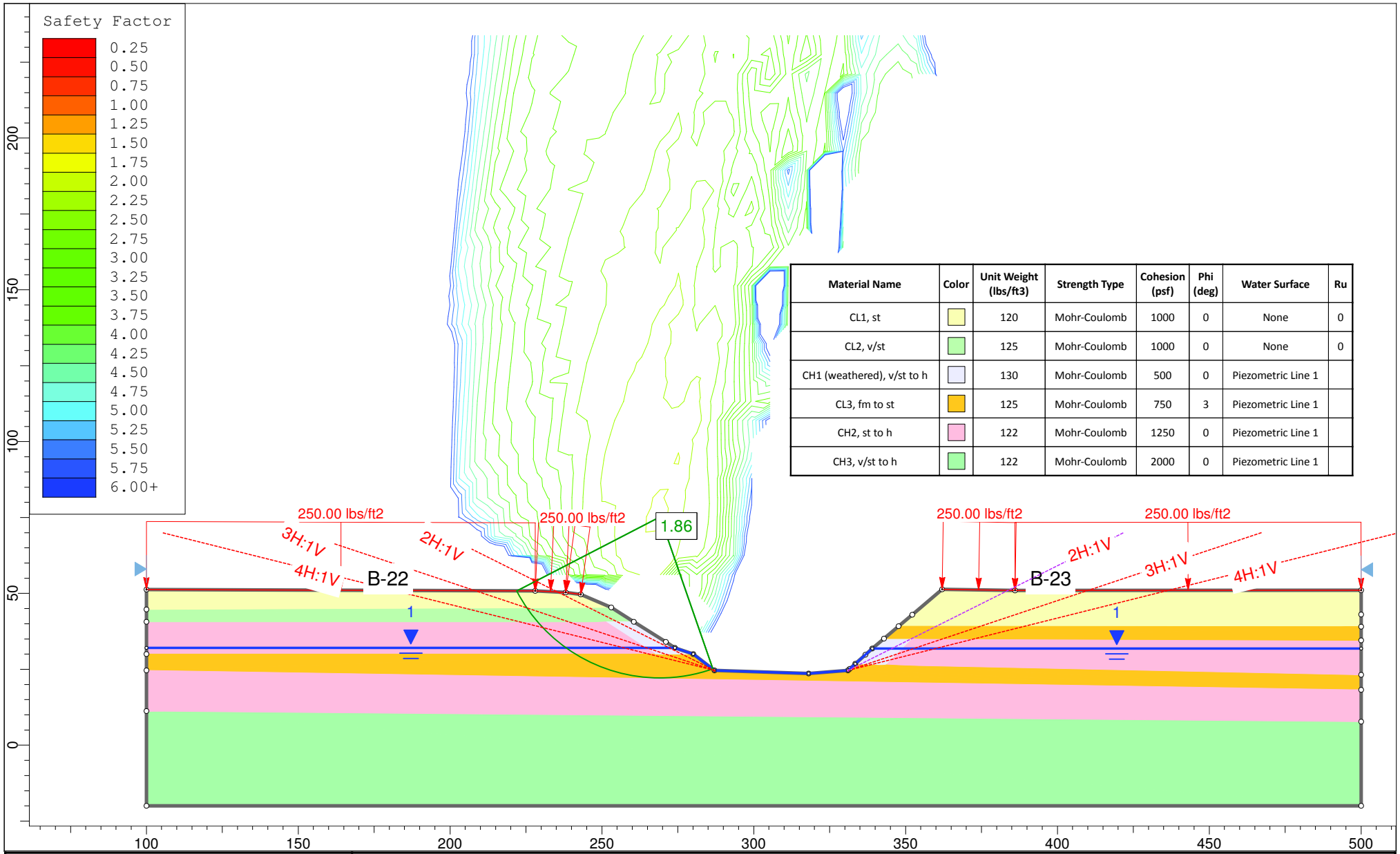
Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)		
Drawn By PST	*Scale* 1:579	*Company* ATL	
Date 5/13/2013		*File Name* G13-120_Bayou at Link Rd_RD_B22B24_4H1V_RtoL.slim	

FIGURE 5-12

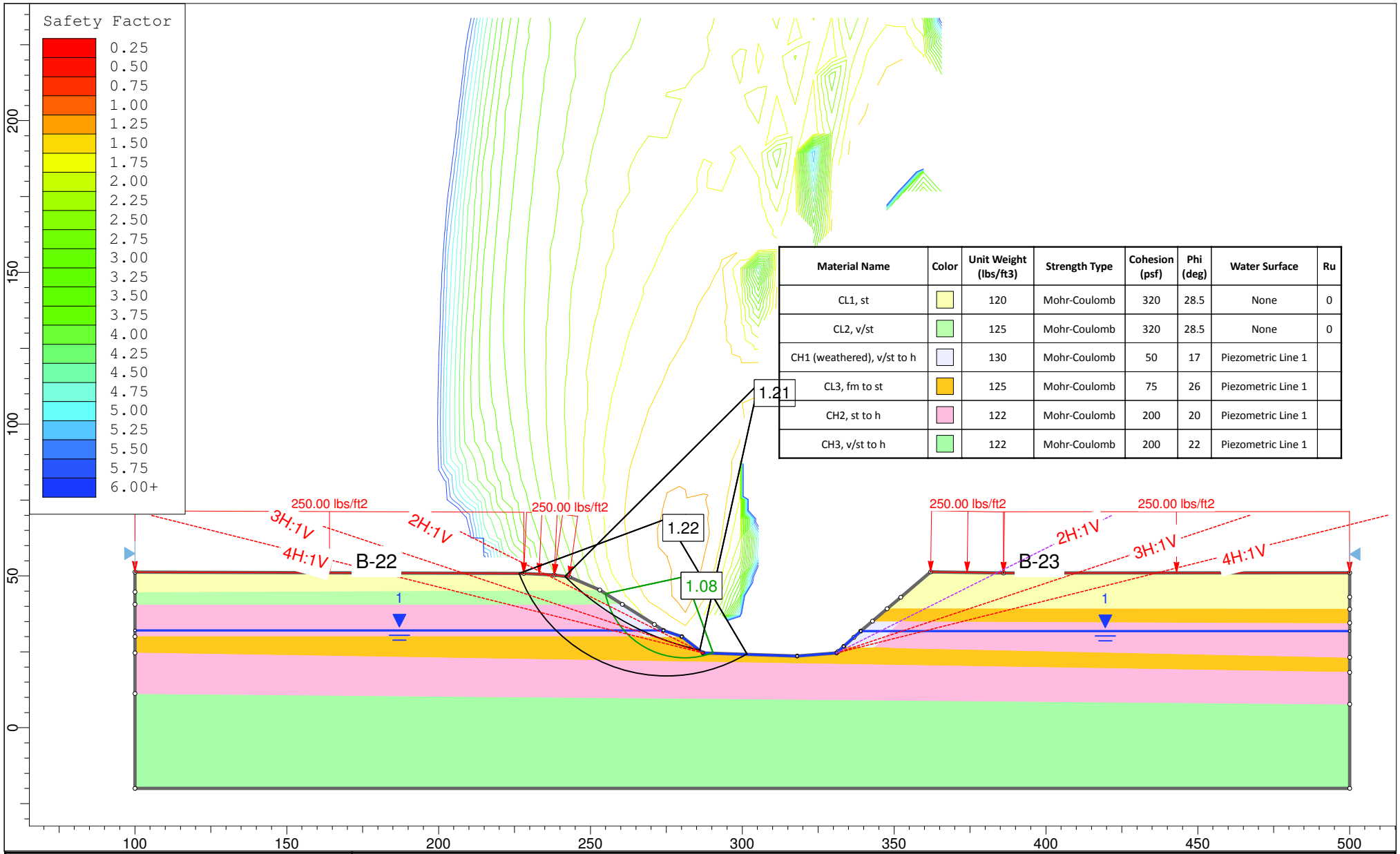


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	1000	0	None	0
CL2, v/st		125	Mohr-Coulomb	1000	0	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	500	0	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	750	3	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	1250	0	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	2000	0	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Short Term Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Enid St_ST_B22B23_LtSlope.slim

SLIDEINTERPRET 6.022

FIGURE 5-13

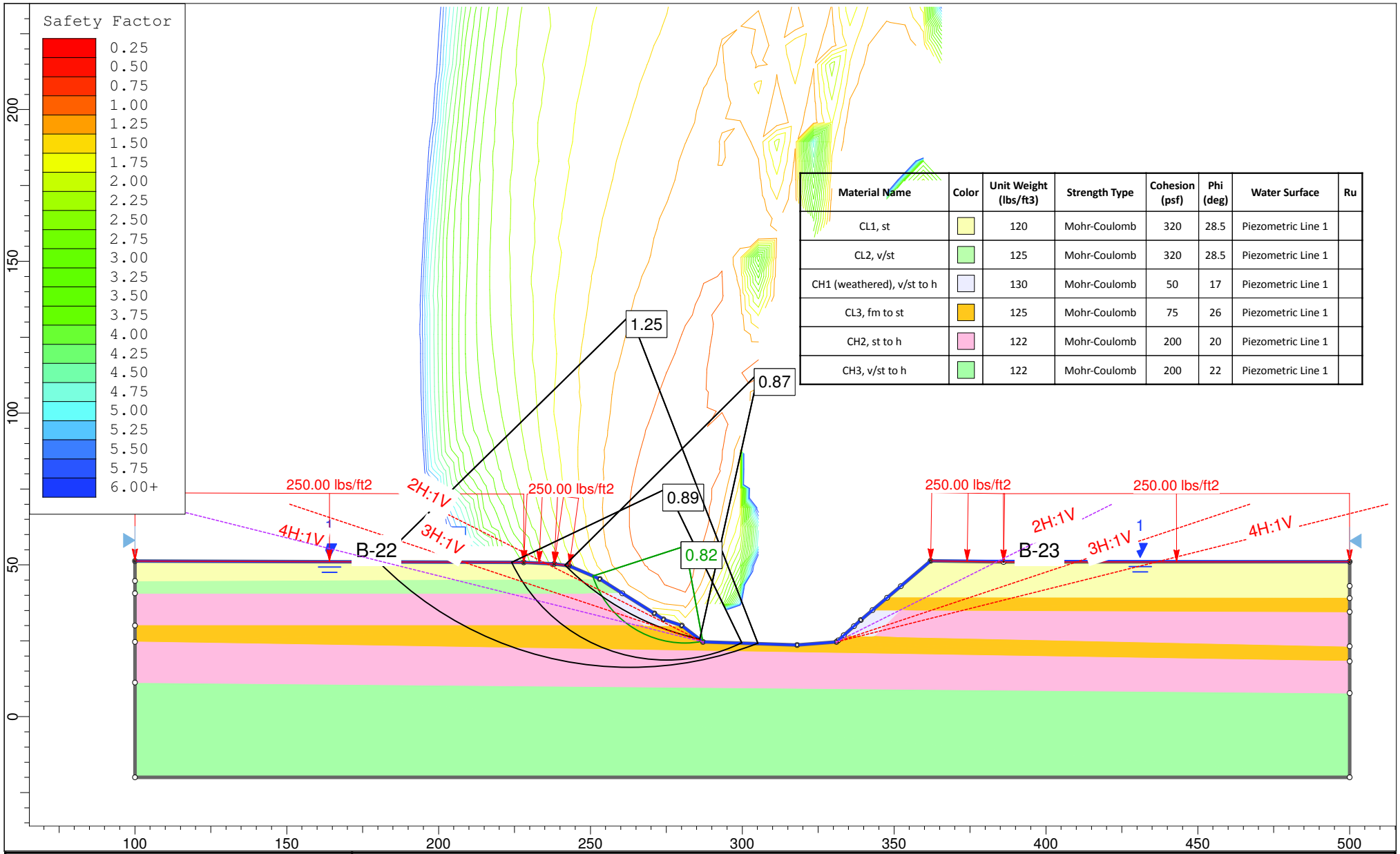


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Enid St_LT_B22B23_LtSlope.slim

SLIDEINTERPRET 6.022

FIGURE 5-14

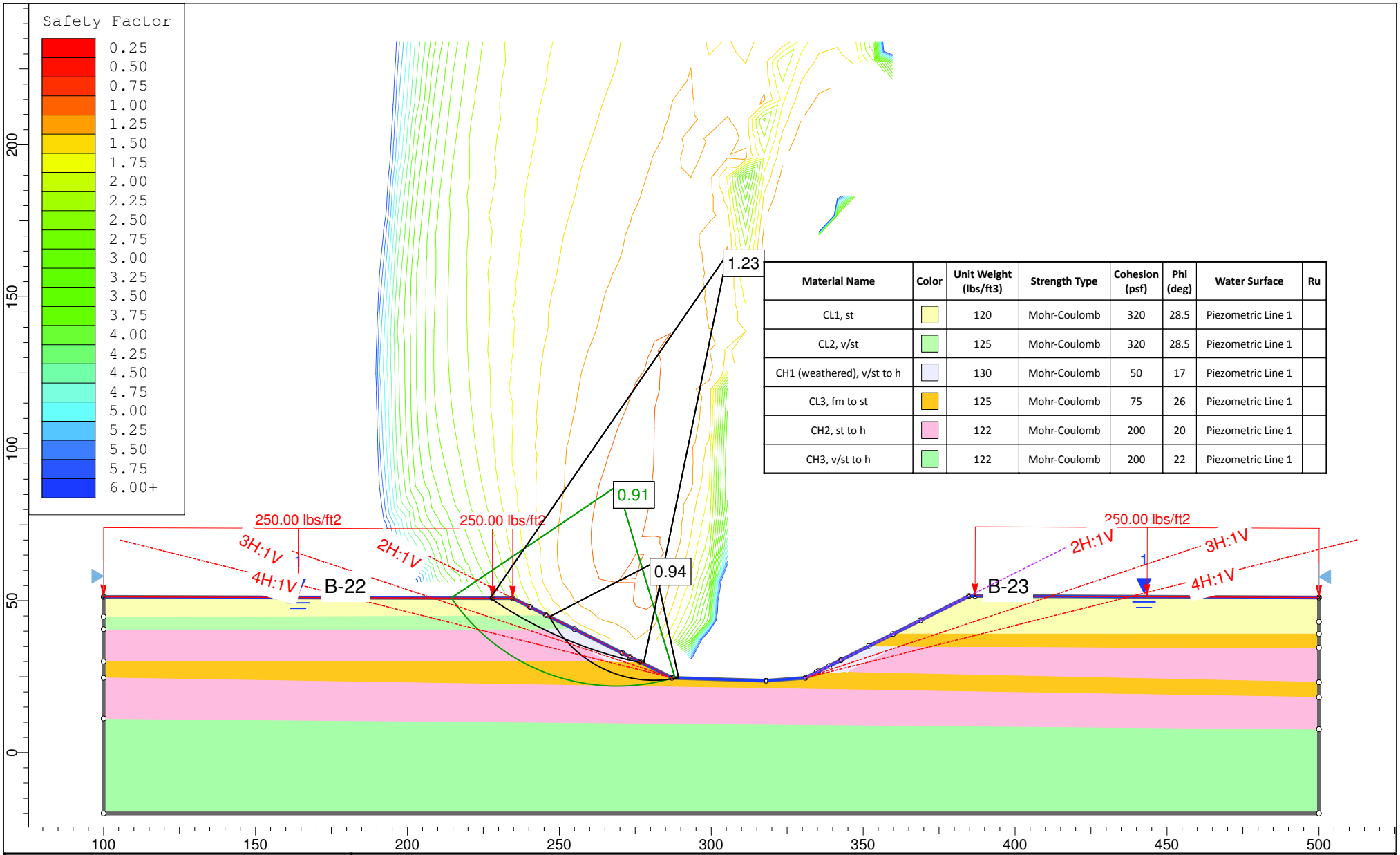


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Ex. Slope_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid St_RD_B22B23_LtSlope.slim

SLIDEINTERPRET 6.022

FIGURE 5-15

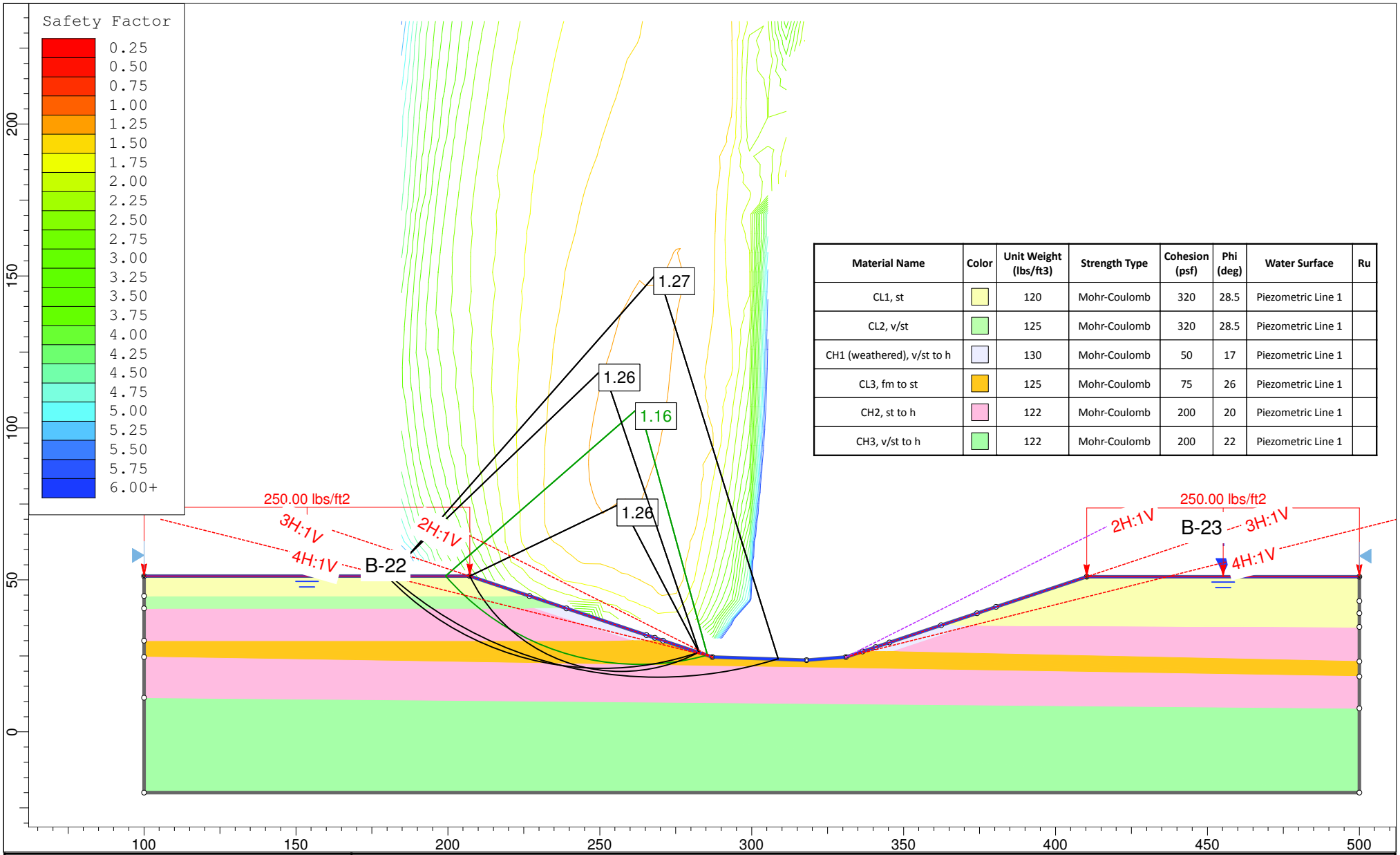


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid_RD_B22B23_LtSlope_2H1V.slim

SLIDEINTERPRET 6.022

FIGURE 5-16

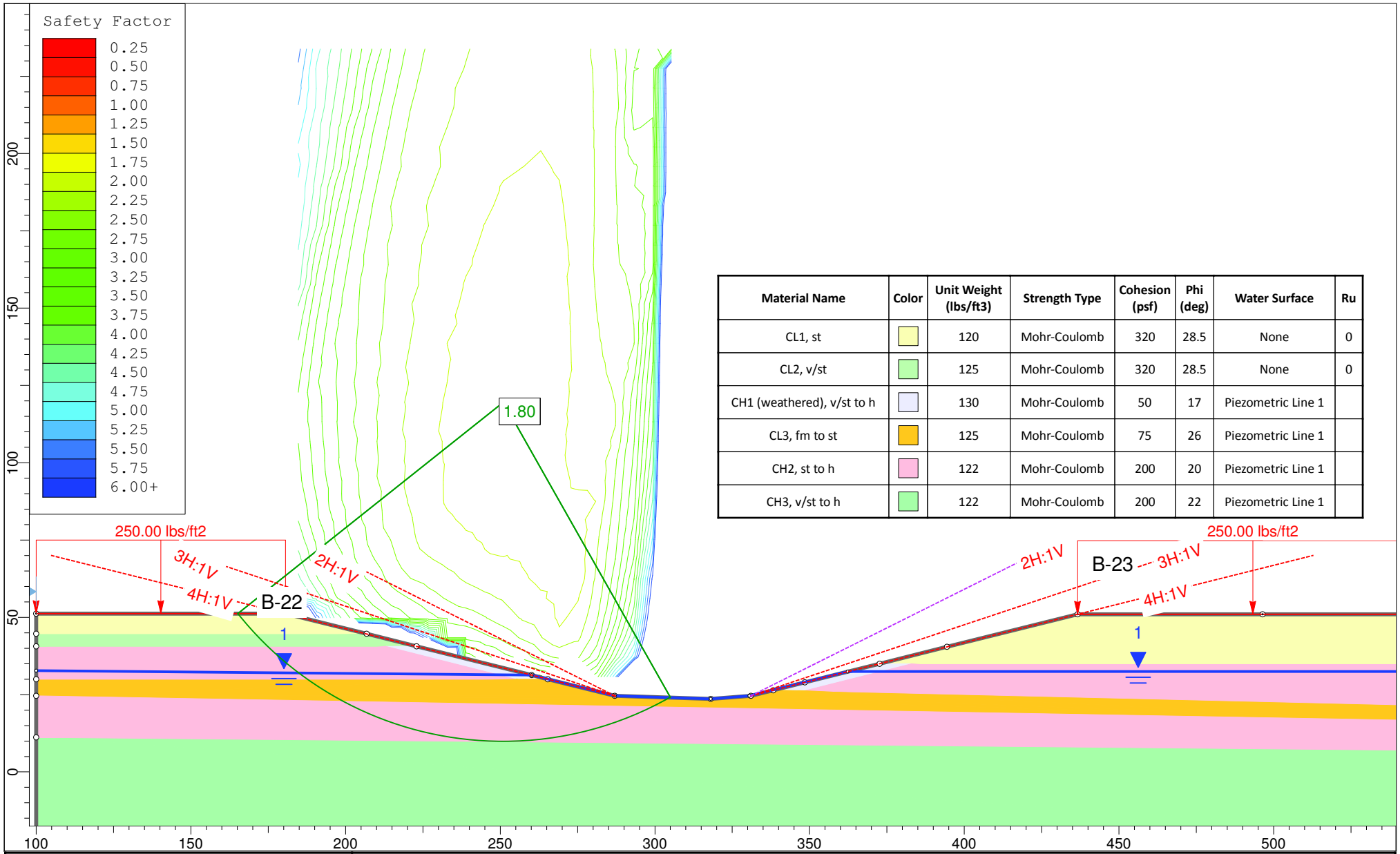


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid_RD_B22B23_LtSlope_3H1V.slim

SLIDEINTERPRET 6.022

FIGURE 5-17

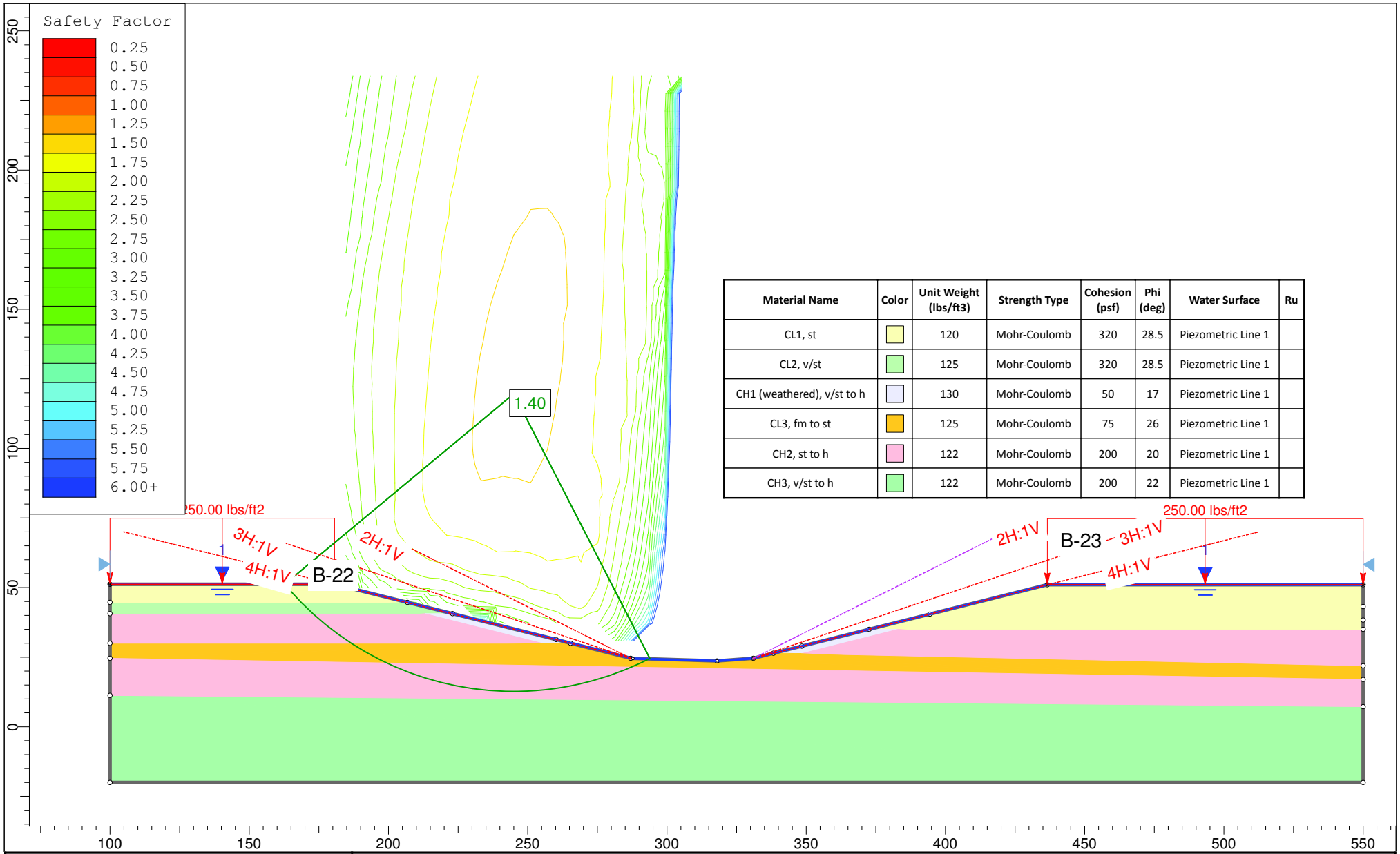


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)		
Drawn By: PST	Scale: 1:514	Company: ATL	
Date: 5/7/2013		File Name: G13-120_Bayou at Enid_LT_B22B23_LtSlope_4H1V.slim	

SLIDEINTERPRET 6.022

FIGURE 5-18

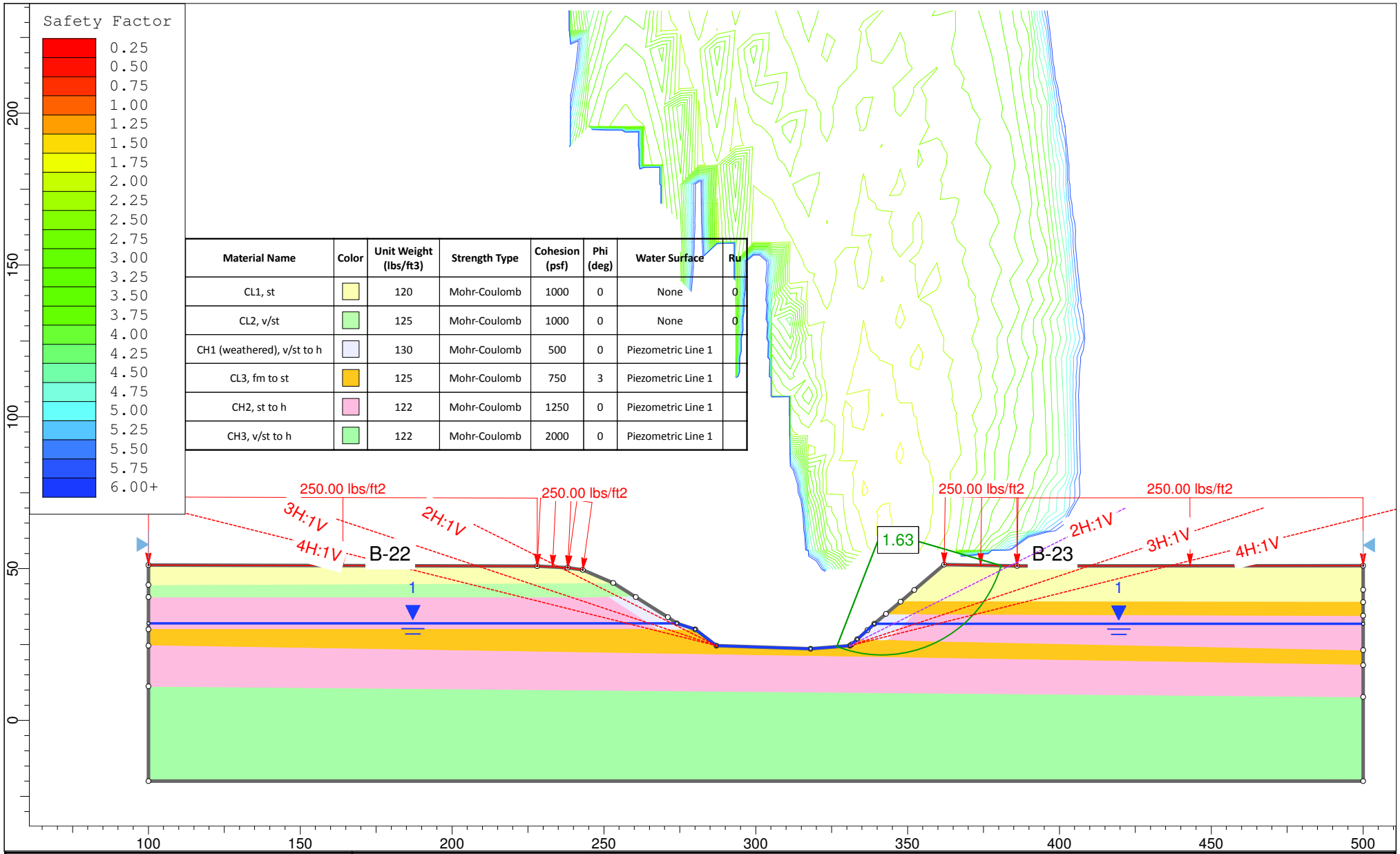


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:572	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid_RD_B22B23_LtSlope_4H1V.slim

SLIDEINTERPRET 6.022

FIGURE 5-19

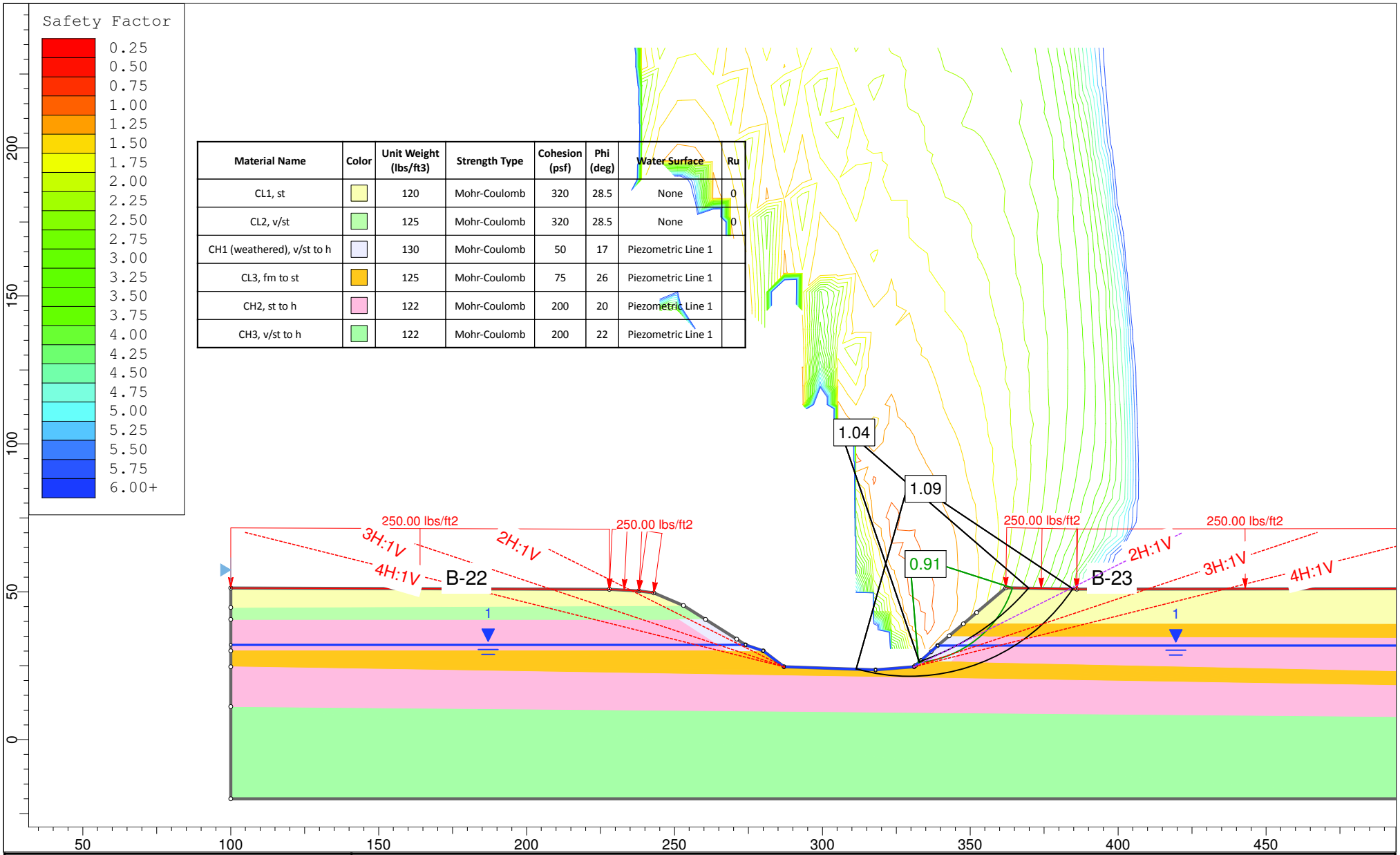


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	1000	0	None	0
CL2, v/st		125	Mohr-Coulomb	1000	0	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	500	0	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	750	3	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	1250	0	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	2000	0	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Short Term Condition (B-22 and B-23)		
Drawn By: PST	Scale: 1:524	Company: ATL	
Date: 5/13/2013		File Name: G13-120_Bayou at Enid St_ST_B22B23_RtSlope.slim	

SLIDEINTERPRET 6.022

FIGURE 5-20

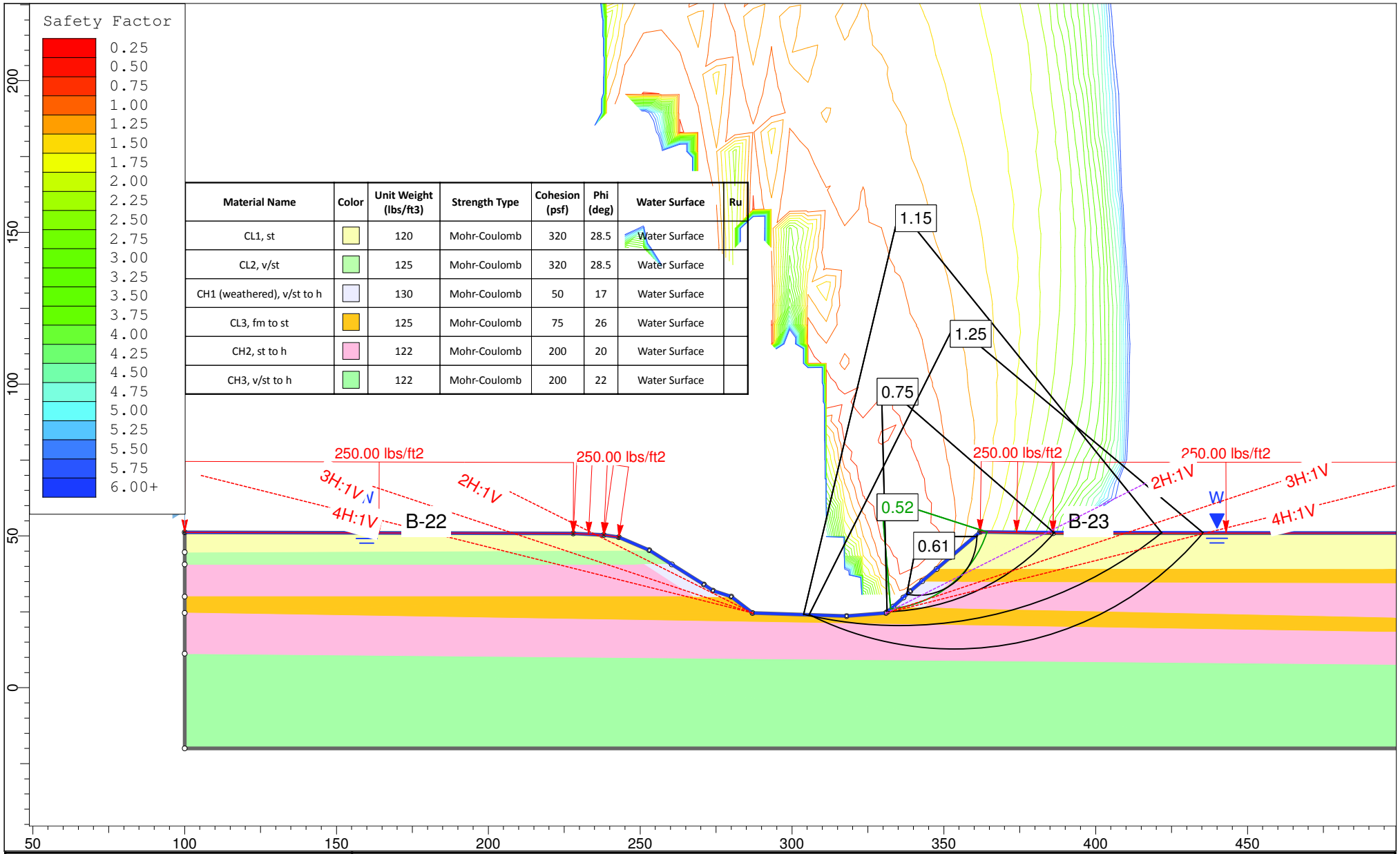


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:538	Company ATL
Date	5/13/2013		File Name G13-120_Bayou at Enid St_LT_B22B23_RtSlope.slim

SLIDEINTERPRET 6.022

FIGURE 5-21

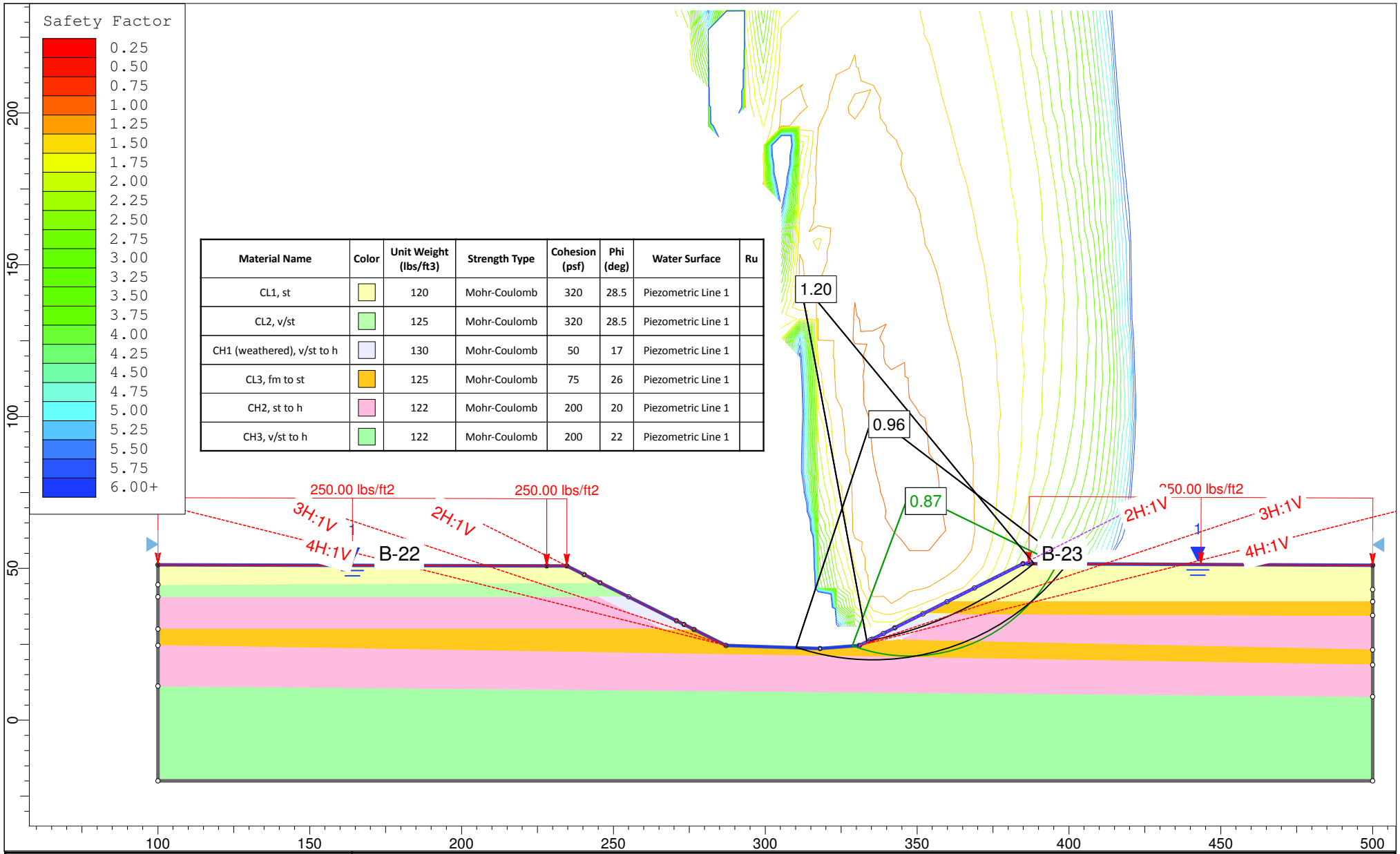


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Water Surface	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Water Surface	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Water Surface	
CL3, fm to st		125	Mohr-Coulomb	75	26	Water Surface	
CH2, st to h		122	Mohr-Coulomb	200	20	Water Surface	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Water Surface	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid St_RD_B22B23_RtSlope.slim

SLIDEINTERPRET 6.022

FIGURE 5-22

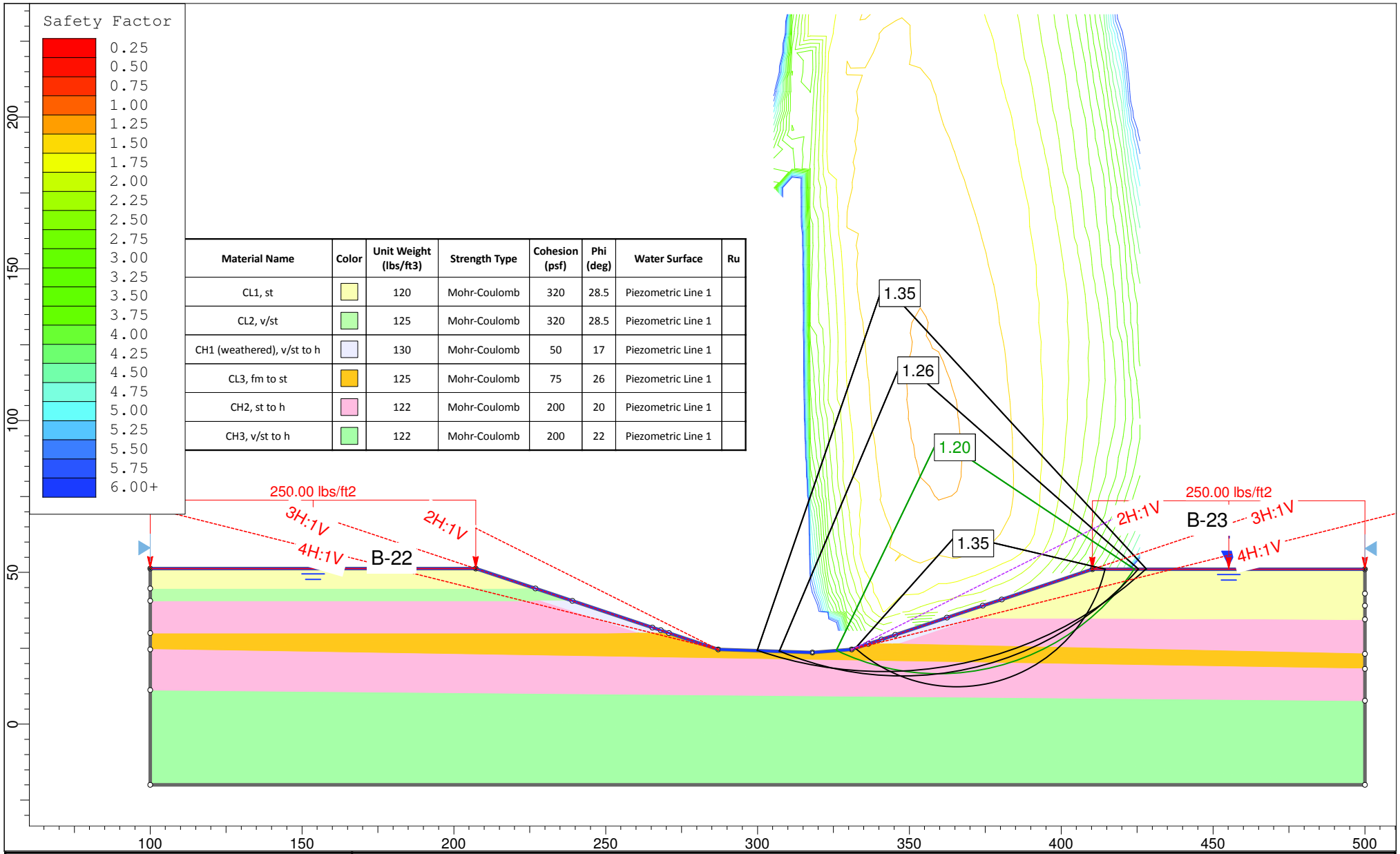


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By PST	*Scale* 1:524	*Company* ATL	
Date 5/7/2013		*File Name* G13-120_Bayou at Enid_RD_B22B23_RtSlope_2H1V.slim	

SLIDEINTERPRET 6.022

FIGURE 5-23

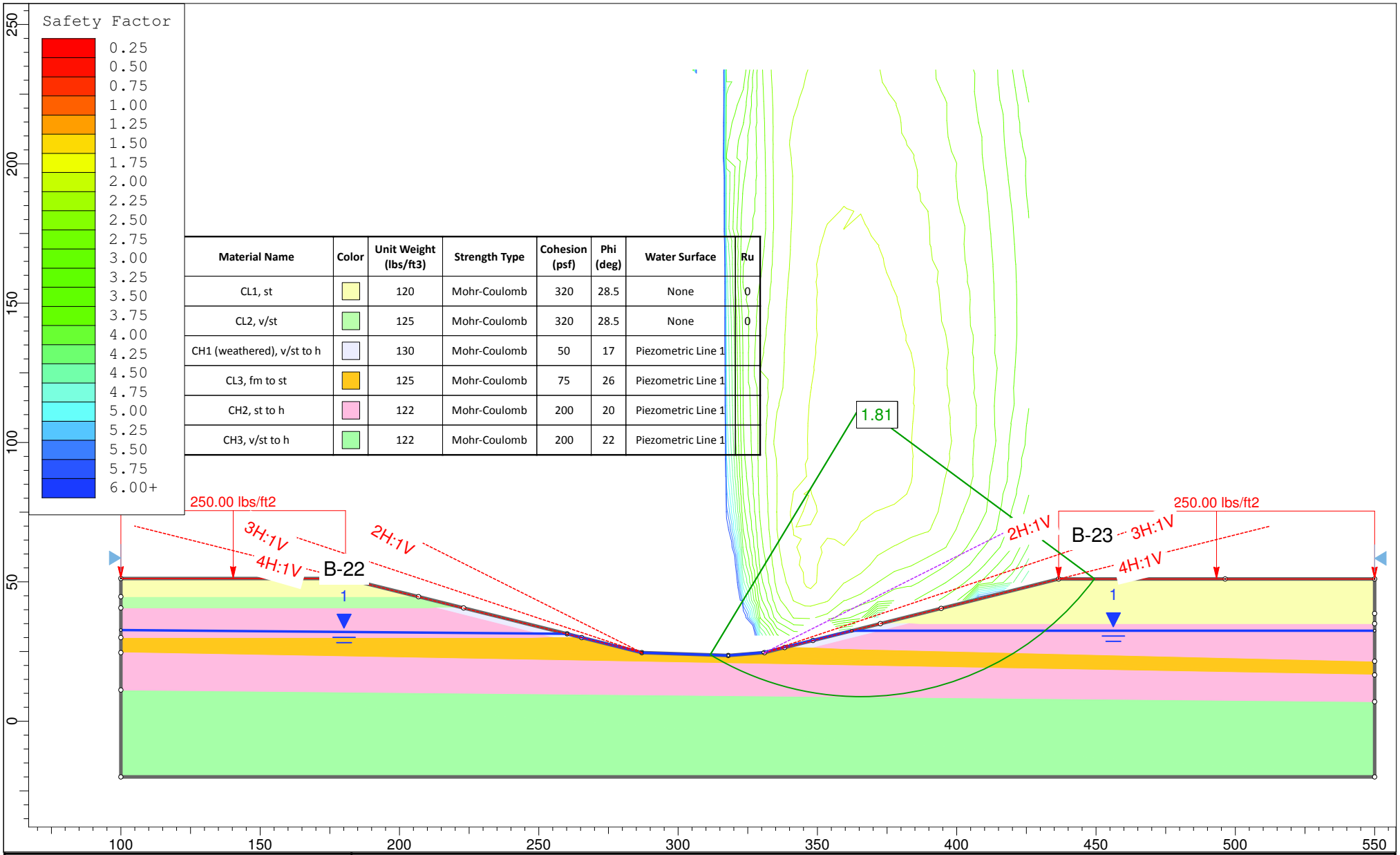


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:524	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid_RD_B22B23_RtSlope_3H1V.slim

SLIDEINTERPRET 6.022

FIGURE 5-24

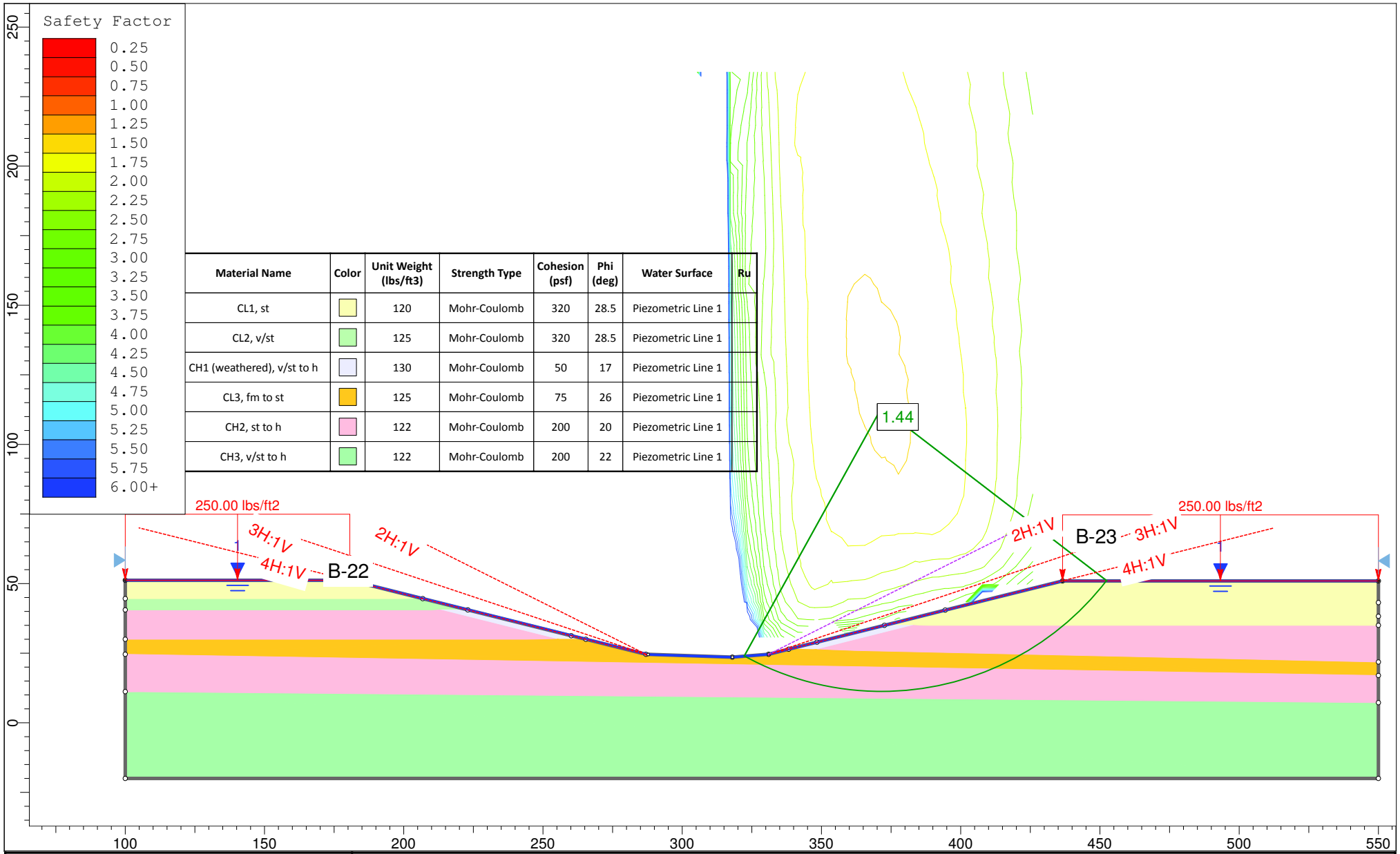


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	None	0
CL2, v/st		125	Mohr-Coulomb	320	28.5	None	0
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)		
Drawn By: PST	Scale: 1:572	Company: ATL	
Date: 5/7/2013		File Name: G13-120_Bayou at Enid_LT_B22B23_RtSlope_4H1V.slim	

SLIDEINTERPRET 6.022

FIGURE 5-25



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
CL1, st		120	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CL2, v/st		125	Mohr-Coulomb	320	28.5	Piezometric Line 1	
CH1 (weathered), v/st to h		130	Mohr-Coulomb	50	17	Piezometric Line 1	
CL3, fm to st		125	Mohr-Coulomb	75	26	Piezometric Line 1	
CH2, st to h		122	Mohr-Coulomb	200	20	Piezometric Line 1	
CH3, v/st to h		122	Mohr-Coulomb	200	22	Piezometric Line 1	

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)		
Drawn By	PST	Scale 1:572	Company ATL
Date	5/7/2013		File Name G13-120_Bayou at Enid_RD_B22B23_RtSlope_4H1V.slim

SLIDEINTERPRET 6.022

FIGURE 5-26

ATL G13-120

Boring	Depth, ft	Type	LL	PI	C_{cu}, psf	ϕ_{cu}, deg.	C'_{cu}, psf	ϕ'_{cu}, deg.	γ, pcf	Cu_u, psf	ϕu_u, deg.	-#200	HP
B-22	4-6; 8-10;10-12'	St to v/st CL	42	24	569	21.9	474	33.4	135		0	83	2-3.5

*from TxCU test, values are on high side, applies a reduction factor of 0.5 for c

$S = c + \sigma' \tan\phi$

Average critical slice depth: **10** ft

Average mid-depth vertical stress = 1350 psf = 64.638351 kPa 9.375 psi

Based on triaxial CU test results:

S(peak, cu, total stress) = 1111.7 psf

S(peak, cu,effective stress) = 1364.2 psf

Weathred strength Correction Factor, η = 0.8

Corrected S (peak, cu, total stress) = 889.36 psf

Corrected S' (peak, cu,effective stress) = 1091.3 psf

Assuming $\phi' = \phi'$natural clay: From Fig 2, ϕ' natrual clay = **28.5** degrees

*for clays of moderate plasticity (RD & LT)

*and considering insitu strength and results of TxCU data

Assuming.Cweathered = Cmobilized: $C_{mobilized} = \eta \cdot S_{peak} - \sigma \tan\phi_{weathered}$

Computed $C'_{mobilized} = \eta \cdot S_{peak} - \sigma \tan\phi_{weathered}$ = 358.34 psf

For slope stab. Analyses, use: c'= 320 psf ; phi' = 28.5 deg. for stiff to very stiff lean clays with moderate plasticity

ATL G13-120

Boring	Depth, ft	Type	LL	PI	C_{cu}, psf	ϕ_{cu}, deg.	C'_{cu}, psf	ϕ'_{cu}, deg.	Y, pcf	Cu_u, psf	ϕu_u, deg.	-#200	HP
B-23	4-6; 10-12;14-16'	So to st CL	39	22	376	18.6	284	30.6	129	0.5-2	0	78	1.0 to 3.5

$S = c + \sigma' \tan\phi$

Assumed critical slice depth : **10** ft

Average vertical stress = 1290 psf = 61.765535 kPa 8.9583333 psi

Based on triaxial CU test results:

S(peak, cu, total stress) = 810.1 psf

S(peak, cu,effective stress) = 1047 psf

Weathred strength Correction Factor, η = 0.8

Corrected S (peak, cu, total stress) = 648.1 psf

Corrected S' (peak, cu,effective stress) = 837.5 psf

Assuming $\phi = \phi$natural clay: From Fig 2, ϕ' natrual clay = **26** degrees

*for clays of moderate plasticity (RD & LT)

*and considering insitu strength and results of TxCU data

Assuming.Cweathered = Cmobilized: $C_{mobilized} = \eta \cdot S_{peak} - \sigma \tan\phi_{weathered}$

Computed $C'_{mobilized} = \eta \cdot S_{peak} - \sigma \tan\phi_{weathered}$ = 208.3 psf

For slope stability analyses, use: c'= 75 psf; phi' = 26 deg. for the soft to stiff Lean Clays of mdoerate plasticity

Correction Factor for Mobilized ("Weathered") Shear Strength (c')

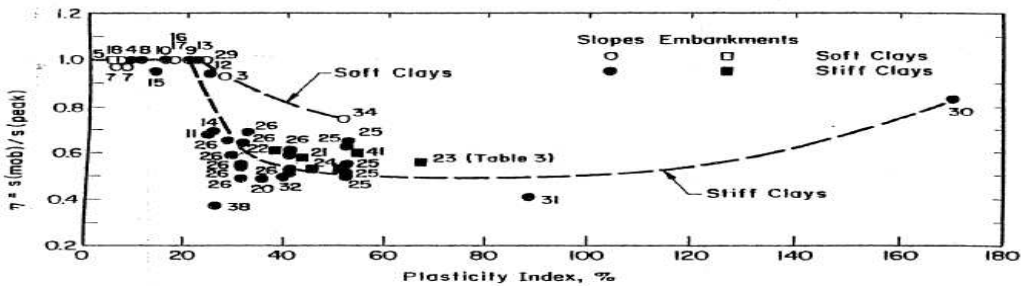


FIG. 13. Correction Factor for Peak Shear Strength Used in Effective Stress Stability Analysis

Friction Angle vs PI

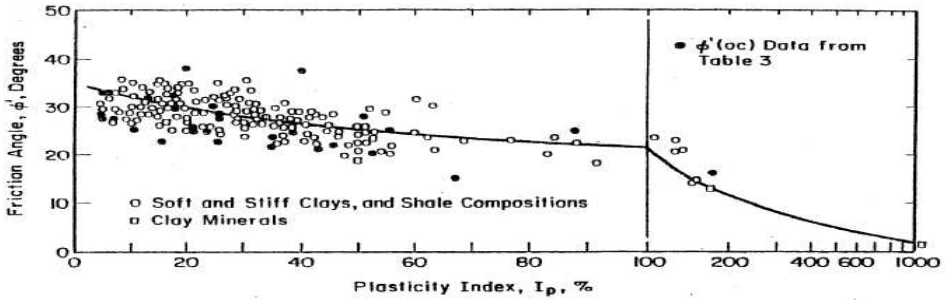


FIG. 2. Values of Friction Angle φ' for Natural Clay Compositions

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid St_ST_B22B23_RtSlope
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Short Term Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	1000	1000	500	750	1250	2000
Friction Angle [deg]	0	0	0	3	0	0
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value			1	1	1	1
Ru Value	0	0				

Global Minimums

Method: bishop simplified

FS: 1.628500
Center: 341.478, 62.481
Radius: 40.999
Left Slip Surface Endpoint: 326.633, 24.264
Right Slip Surface Endpoint: 380.833, 50.986
Resisting Moment=2.62461e+006 lb-ft
Driving Moment=1.61167e+006 lb-ft
Total Slice Area=765.947 ft2

Method: janbu simplified

FS: 1.676220
Center: 341.478, 62.481
Radius: 40.999
Left Slip Surface Endpoint: 326.633, 24.264
Right Slip Surface Endpoint: 380.833, 50.986
Resisting Horizontal Force=50070.5 lb
Driving Horizontal Force=29871.1 lb
Total Slice Area=765.947 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.6285

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.24609	136.297	CL3, fm to st	750	3	466.875	760.306	226.945	30.2924	196.653
2	2.24609	389.632	CL3, fm to st	750	3	467.748	761.728	310.206	86.4164	223.79
3	2.24609	890.727	CL3, fm to st	750	3	470.445	766.12	505.549	197.966	307.583

4	2.24609	1597.16	CL3, fm to st	750	3	474.737	773.108	793.356	352.424	440.932
5	2.24609	2279.47	CL3, fm to st	750	3	478.951	779.971	1070.72	498.839	571.882
6	2.24609	2922.29	CL3, fm to st	750	3	482.852	786.325	1330.52	637.403	693.122
7	2.24609	3504.64	CL3, fm to st	750	3	490.168	798.238	1563.26	642.825	920.439
8	2.24609	4038.01	CL3, fm to st	750	3	497.028	809.411	1773.44	639.82	1133.62
9	2.24609	4491.2	CL3, fm to st	750	3	502.96	819.071	1947.04	629.093	1317.95
10	2.24609	4897.06	CL3, fm to st	750	3	508.431	827.98	2098.5	610.547	1487.95
11	2.24609	5251.36	CL3, fm to st	750	3	513.379	836.038	2225.7	584.007	1641.69
12	2.24609	5574.12	CL3, fm to st	750	3	518.088	843.706	2337.23	549.214	1788.02
13	2.24609	5888.3	CL3, fm to st	750	3	522.882	851.514	2442.81	505.81	1937
14	2.24609	6165.12	CL3, fm to st	750	3	527.353	858.795	2529.25	453.321	2075.93
15	2.24609	6398.24	CL3, fm to st	750	3	531.411	865.403	2593.15	391.122	2202.02
16	2.31064	6758.91	CH2, st to h	1250	0	767.578	1250	2563.65	317.188	2246.46
17	2.31064	6500.24	CH2, st to h	1250	0	767.578	1250	2563.75	230.065	2333.69
18	2.31064	6033.28	CH2, st to h	1250	0	767.578	1250	2282.7	129.056	2153.65
19	2.31064	5493.63	CH2, st to h	1250	0	767.578	1250	1956.42	11.9575	1944.46
20	2.31064	4866.84	CH2, st to h	1250	0	767.578	1250	1572.06	0	1572.06
21	1.63951	3013.61	CL3, fm to st	750	3	508.459	828.025	1488.81	0	1488.81
22	1.63951	2585.14	CL3, fm to st	750	3	497.786	810.644	1157.16	0	1157.16
23	1.89183	2376.34	CL1, st	1000	0	614.062	1000	532.39	0	532.39
24	1.89183	1606.04	CL1, st	1000	0	614.062	1000	-114.363	0	-114.363
25	1.89183	589.543	CL1, st	1000	0	614.062	1000	-1117.62	0	-1117.62

Global Minimum Query (janbu simplified) - Safety Factor: 1.67622

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.24609	136.297	CL3, fm to st	750	3	453.438	760.061	222.269	30.2924	191.977
2	2.24609	389.632	CL3, fm to st	750	3	454.312	761.527	306.368	86.4164	219.951
3	2.24609	890.727	CL3, fm to st	750	3	456.956	765.96	502.495	197.966	304.529
4	2.24609	1597.16	CL3, fm to st	750	3	461.149	772.988	791.057	352.424	438.633

5	2.24609	2279.47	CL3, fm to st	750	3	465.267	779.889	1069.16	498.839	570.321
6	2.24609	2922.29	CL3, fm to st	750	3	469.08	786.282	1329.7	637.403	692.3
7	2.24609	3504.64	CL3, fm to st	750	3	476.211	798.234	1563.18	642.825	920.359
8	2.24609	4038.01	CL3, fm to st	750	3	482.9	809.446	1774.12	639.82	1134.3
9	2.24609	4491.2	CL3, fm to st	750	3	488.687	819.147	1948.5	629.093	1319.41
10	2.24609	4897.06	CL3, fm to st	750	3	494.027	828.099	2100.76	610.547	1490.21
11	2.24609	5251.36	CL3, fm to st	750	3	498.861	836.2	2228.8	584.007	1644.8
12	2.24609	5574.12	CL3, fm to st	750	3	503.463	843.915	2341.21	549.214	1792
13	2.24609	5888.3	CL3, fm to st	750	3	508.15	851.772	2447.74	505.81	1941.93
14	2.24609	6165.12	CL3, fm to st	750	3	512.525	859.105	2535.17	453.321	2081.85
15	2.24609	6398.24	CL3, fm to st	750	3	516.501	865.77	2600.15	391.122	2209.02
16	2.31064	6758.91	CH2, st to h	1250	0	745.726	1250	2575.62	317.188	2258.43
17	2.31064	6500.24	CH2, st to h	1250	0	745.726	1250	2577.64	230.065	2347.58
18	2.31064	6033.28	CH2, st to h	1250	0	745.726	1250	2298.79	129.056	2169.73
19	2.31064	5493.63	CH2, st to h	1250	0	745.726	1250	1975.09	11.9575	1963.13
20	2.31064	4866.84	CH2, st to h	1250	0	745.726	1250	1593.87	0	1593.87
21	1.63951	3013.61	CL3, fm to st	750	3	494.486	828.868	1504.89	0	1504.89
22	1.63951	2585.14	CL3, fm to st	750	3	484.173	811.581	1175.04	0	1175.04
23	1.89183	2376.34	CL1, st	1000	0	596.58	1000	559.472	0	559.472
24	1.89183	1606.04	CL1, st	1000	0	596.58	1000	-80.6186	0	-80.6186
25	1.89183	589.543	CL1, st	1000	0	596.58	1000	-1070.92	0	-1070.92

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.6285

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	326.633	24.2641	0	0	0
2	328.879	23.466	1232.07	0	0
3	331.126	22.8108	2488.21	0	0
4	333.372	22.2916	3809.65	0	0
5	335.618	21.9032	5186.44	0	0
6	337.864	21.6418	6544.43	0	0
7	340.11	21.505	7813.34	0	0

8	342.356	21.4916	8937.72	0	0
9	344.602	21.6014	9861.83	0	0
10	346.848	21.8354	10538.4	0	0
11	349.094	22.1958	10926.5	0	0
12	351.34	22.686	10991	0	0
13	353.587	23.311	10696.6	0	0
14	355.833	24.0772	10001.9	0	0
15	358.079	24.9933	8871.85	0	0
16	360.325	26.0707	7274.2	0	0
17	362.635	27.363	5736.07	0	0
18	364.946	28.8631	3657.94	0	0
19	367.257	30.6004	1460.02	0	0
20	369.567	32.6163	-716	0	0
21	371.878	34.9719	-2651.25	0	0
22	373.518	36.9001	-4693.42	0	0
23	375.157	39.1007	-6428.84	0	0
24	377.049	42.0941	-6866.1	0	0
25	378.941	45.8239	-5283.19	0	0
26	380.833	50.9861	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.67622

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	326.633	24.2641	0	0	0
2	328.879	23.466	1198.78	0	0
3	331.126	22.8108	2422.85	0	0
4	333.372	22.2916	3713.04	0	0
5	335.618	21.9032	5059.05	0	0
6	337.864	21.6418	6386.54	0	0
7	340.11	21.505	7625.05	0	0
8	342.356	21.4916	8718.74	0	0
9	344.602	21.6014	9611.7	0	0
10	346.848	21.8354	10256.5	0	0
11	349.094	22.1958	10612.2	0	0
12	351.34	22.686	10643.2	0	0
13	353.587	23.311	10314.2	0	0
14	355.833	24.0772	9583.35	0	0
15	358.079	24.9933	8415.24	0	0
16	360.325	26.0707	6777.28	0	0
17	362.635	27.363	5174.24	0	0
18	364.946	28.8631	3025.84	0	0
19	367.257	30.6004	750.535	0	0
20	369.567	32.6163	-1512.54	0	0
21	371.878	34.9719	-3548.61	0	0
22	373.518	36.9001	-5644.18	0	0
23	375.157	39.1007	-7440.76	0	0

24	377.049	42.0941	-7991.47	0	0
25	378.941	45.8239	-6566.8	0	0
26	380.833	50.9861	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid St_LT_B22B23_RtSlope
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value			1	1	1	1
Ru Value	0	0				

Global Minimums

Method: bishop simplified

FS: 0.905711
Center: 329.418, 62.481
Radius: 36.667
Left Slip Surface Endpoint: 332.492, 25.943
Right Slip Surface Endpoint: 364.326, 51.261
Resisting Moment=492570 lb-ft
Driving Moment=543849 lb-ft
Total Slice Area=203.516 ft2

Method: janbu simplified

FS: 0.799212
Center: 335.448, 37.102
Radius: 14.281
Left Slip Surface Endpoint: 328.854, 24.435
Right Slip Surface Endpoint: 349.729, 37.102
Left Slope Intercept: 328.854 24.435
Right Slope Intercept: 349.729 40.896
Resisting Horizontal Force=5699.2 lb
Driving Horizontal Force=7131.02 lb
Total Slice Area=143.98 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.905711

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.16221	67.6697	CL3, fm to st	75	26	93.5107	84.6936	48.8766	29.0016	19.875
2	1.16221	204.354	CL3, fm to st	75	26	122.546	110.992	159.625	85.8319	73.7936
3	1.16221	337.47	CL3, fm to st	75	26	150.273	136.104	265.583	140.301	125.282
4	1.16221	465.008	CL3, fm to st	75	26	175.903	159.317	365.25	192.375	172.875

5	1.23664	627.383	CH1 (weathered), v/st to h	50	17	133.733	121.124	476.153	243.518	232.635
6	1.23664	754.899	CH1 (weathered), v/st to h	50	17	148.64	134.625	570.305	293.51	276.795
7	1.23664	867.173	CH1 (weathered), v/st to h	50	17	181.441	164.333	645.345	271.377	373.968
8	1.23664	970.44	CH1 (weathered), v/st to h	50	17	212.177	192.171	711.055	246.036	465.019
9	1.23664	1065.3	CH1 (weathered), v/st to h	50	17	240.976	218.255	767.94	217.602	550.338
10	1.23664	1147.09	CH1 (weathered), v/st to h	50	17	266.78	241.626	812.733	185.949	626.784
11	1.23664	1218.91	CH1 (weathered), v/st to h	50	17	290.403	263.021	847.687	150.929	696.758
12	1.23664	1281.6	CH1 (weathered), v/st to h	50	17	312.098	282.671	873.4	112.366	761.034
13	1.23664	1333.79	CH1 (weathered), v/st to h	50	17	331.601	300.335	888.861	70.0538	818.807
14	1.36674	1513.69	CH2, st to h	200	20	524.874	475.384	777.689	21.0756	756.613
15	1.36674	1537.85	CH2, st to h	200	20	526.469	476.829	760.582	0	760.582
16	1.36674	1546.67	CH2, st to h	200	20	517.03	468.28	737.094	0	737.094
17	1.36674	1546.96	CH2, st to h	200	20	504.89	457.284	706.885	0	706.885
18	1.31336	1472.87	CL3, fm to st	75	26	457.757	414.596	696.273	0	696.273
19	1.31336	1437.03	CL3, fm to st	75	26	432.723	391.922	649.789	0	649.789
20	1.31336	1378.15	CL3, fm to st	75	26	401.163	363.338	591.18	0	591.18
21	1.3297	1312.82	CL1, st	320	28.5	534.421	484.031	302.107	0	302.107
22	1.3297	1201.2	CL1, st	320	28.5	477.269	432.268	206.771	0	206.771
23	1.3297	1045.56	CL1, st	320	28.5	408.913	370.357	92.7452	0	92.7452
24	1.3297	776.561	CL1, st	320	28.5	366.86	332.269	22.5961	0	22.5961
25	1.3297	281.763	CL1, st	320	28.5	244.394	221.351	-181.689	0	-181.689

Global Minimum Query (janbu simplified) - Safety Factor: 0.799212

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.844344	24.7971	CL3, fm to st	75	26	145.111	115.974	98.6708	14.6607	84.0101
2	0.844344	70.9493	CL3, fm to st	75	26	158.206	126.44	147.416	41.9473	105.469
3	0.844344	118.172	CL3, fm to st	75	26	174.474	139.442	197.44	65.3153	132.125
4	0.844344	214.099	CL3, fm to st	75	26	204.03	163.063	307.137	126.581	180.556
5	0.844344	314.946	CL3, fm to st	75	26	236.542	189.047	420.037	186.205	233.832
6	0.844344	410.82	CL3, fm to st	75	26	264.984	211.778	522.953	242.517	280.436
7	0.844344	503.712	CL3, fm to st	75	26	291.263	232.781	619.117	295.617	323.5
8	0.844344	591.523	CL3, fm to st	75	26	313.991	250.945	706.308	345.566	360.742
9	0.844344	674.05	CL3, fm to st	75	26	333.291	266.37	784.758	392.392	392.366
10	0.844344	751.285	CL3, fm to st	75	26	349.389	279.236	854.833	436.088	418.745
11	0.844344	823.157	CL3, fm to st	75	26	362.438	289.665	916.743	476.615	440.128
12	0.844344	889.541	CL3, fm to st	75	26	372.531	297.731	970.563	513.896	456.667
13	0.844344	947.902	CL3, fm to st	75	26	390.168	311.827	1010.46	524.896	485.567

14	0.844344	997.805	CL3, fm to st	75	26	414.956	331.638	1034.06	507.873	526.186
15	0.844344	1041.37	CL3, fm to st	75	26	435.27	347.873	1046.58	487.105	559.472
16	0.844344	1078.11	CL3, fm to st	75	26	450.954	360.408	1047.47	462.297	585.173
17	0.844344	1107.09	CL3, fm to st	75	26	461.61	368.924	1035.68	433.051	602.633
18	0.844344	1124.81	CL3, fm to st	75	26	465.504	372.036	1007.84	398.83	609.011
19	0.844344	1127.91	CL3, fm to st	75	26	461.188	368.587	960.827	358.887	601.94
20	0.891746	1181.9	CH2, st to h	200	20	495.926	396.35	850.067	310.597	539.47
21	0.891746	1157.05	CH2, st to h	200	20	476.742	381.018	749.016	251.673	497.343
22	0.891746	1109.68	CH2, st to h	200	20	446.28	356.672	610.281	179.829	430.452
23	0.891746	1026.09	CH2, st to h	200	20	397.039	317.318	410.363	88.0349	322.328
24	1.11835	1004.78	CH1 (weathered), v/st to h	50	17	176.251	140.862	297.197	0	297.197
25	0.14745	86.3862	CL3, fm to st	75	26	47.8359	38.231	-75.3877	0	-75.3877

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.905711

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	332.492	25.943	0	0	0
2	333.654	26.0595	102.744	0	0
3	334.817	26.2135	220.259	0	0
4	335.979	26.4057	343.491	0	0
5	337.141	26.6365	463.162	0	0
6	338.378	26.9254	490.592	0	0
7	339.614	27.2601	483.114	0	0
8	340.851	27.6419	460.61	0	0
9	342.088	28.0723	416.353	0	0
10	343.324	28.5532	344.367	0	0
11	344.561	29.0868	239.865	0	0
12	345.798	29.6757	99.0206	0	0
13	347.034	30.3228	-81.0991	0	0
14	348.271	31.0319	-302.168	0	0
15	349.638	31.8926	-255.839	0	0
16	351.004	32.8413	-259.459	0	0
17	352.371	33.8867	-324.901	0	0
18	353.738	35.0397	-451.436	0	0
19	355.051	36.2623	-702.866	0	0
20	356.365	37.6141	-1014.18	0	0
21	357.678	39.1174	-1377.22	0	0
22	359.008	40.8261	-1184.4	0	0
23	360.337	42.7712	-953.388	0	0
24	361.667	45.0316	-620.518	0	0
25	362.997	47.7517	-199.416	0	0
26	364.326	51.2612	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.799212

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	328.854	24.4349	0	0	0
2	329.698	24.03	161.965	0	0
3	330.543	23.6902	345.064	0	0
4	331.387	23.4109	546.916	0	0
5	332.231	23.1883	786.839	0	0
6	333.076	23.0197	1056.53	0	0
7	333.92	22.9032	1340.24	0	0
8	334.764	22.8376	1625.76	0	0
9	335.609	22.8221	1900.7	0	0
10	336.453	22.8566	2153.87	0	0
11	337.297	22.9414	2375.13	0	0
12	338.142	23.0775	2555.11	0	0
13	338.986	23.2663	2685.06	0	0
14	339.83	23.5101	2766.75	0	0
15	340.675	23.8119	2803.57	0	0
16	341.519	24.1757	2788.76	0	0
17	342.363	24.6071	2716.13	0	0
18	343.208	25.1131	2580.13	0	0
19	344.052	25.7039	2376.14	0	0
20	344.896	26.3933	2101.44	0	0
21	345.788	27.2516	1812.22	0	0
22	346.68	28.2819	1463.85	0	0
23	347.572	29.5543	1083.62	0	0
24	348.463	31.224	751.003	0	0
25	349.582	35.0552	-191.327	0	0
26	349.729	37.1021	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid_LT_B22B23_RtSlope_4H1V
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Long Term Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/7/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value			1	1	1	1
Ru Value	0	0				

Global Minimums

Method: bishop simplified

FS: 1.805150
Center: 365.598, 113.238
Radius: 104.515
Left Slip Surface Endpoint: 311.506, 23.809
Right Slip Surface Endpoint: 449.562, 51.000
Resisting Moment=1.18205e+007 lb-ft
Driving Moment=6.54818e+006 lb-ft
Total Slice Area=2580.02 ft2

Method: janbu simplified

FS: 1.663000
Center: 371.628, 100.549
Radius: 91.726
Left Slip Surface Endpoint: 321.312, 23.855
Right Slip Surface Endpoint: 448.820, 51.000
Resisting Horizontal Force=96800.3 lb
Driving Horizontal Force=58208.2 lb
Total Slice Area=2515.35 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.80515

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.43689	983.804	CL3, fm to st	75	26	77.9259	140.668	224.969	90.3301	134.639
2	5.87424	3240.12	CH2, st to h	200	20	184.141	332.402	641.228	277.457	363.771
3	5.87424	5459.12	CH2, st to h	200	20	221.29	399.461	1020.65	472.64	548.014
4	5.87424	7522.54	CH2, st to h	200	20	255.091	460.477	1368.33	652.674	715.655
5	5.87424	9859.5	CH2, st to h	200	20	292.969	528.853	1760.24	856.734	903.511

6	5.87424	12021.8	CH2, st to h	200	20	328.635	593.236	2118.08	1037.67	1080.41
7	5.87424	13924.2	CH2, st to h	200	20	358.959	647.975	2427.27	1196.47	1230.8
8	5.87424	15525.6	CH2, st to h	200	20	382.531	690.525	2681.55	1333.83	1347.72
9	5.87424	16881.6	CH2, st to h	200	20	401.398	724.584	2891.53	1450.24	1441.29
10	5.87424	17999.8	CH2, st to h	200	20	429.794	775.842	3058.94	1476.83	1582.11
11	5.87424	18869	CH2, st to h	200	20	457.344	825.575	3180.77	1462.02	1718.75
12	5.87424	19434.7	CH2, st to h	200	20	478.152	863.136	3248.36	1426.42	1821.94
13	5.87424	19767.9	CH2, st to h	200	20	494.79	893.171	3274.16	1369.68	1904.48
14	5.87424	19899.4	CH2, st to h	200	20	508.447	917.824	3263.43	1291.24	1972.19
15	5.87424	19774.3	CH2, st to h	200	20	517.515	934.193	3207.44	1190.26	2017.18
16	5.87424	19377.6	CH2, st to h	200	20	521.787	941.904	3103.99	1065.63	2038.36
17	5.87424	18692.1	CH2, st to h	200	20	521.059	940.59	2950.62	915.862	2034.76
18	4.97311	15045.7	CL3, fm to st	75	26	575.087	1038.12	2729.28	754.605	1974.68
19	4.97311	14085	CL3, fm to st	75	26	560.355	1011.52	2504.03	583.874	1920.15
20	4.67228	12177.5	CH2, st to h	200	20	490.883	886.118	2281.74	396.65	1885.09
21	4.67228	10963.2	CH2, st to h	200	20	474.169	855.947	1994.23	192.03	1802.2
22	4.67228	9517.26	CH2, st to h	200	20	446.342	805.714	1664.18	0	1664.18
23	4.88918	7989.65	CL1, st	320	28.5	558.89	1008.88	1268.76	0	1268.76
24	4.88918	5129.84	CL1, st	320	28.5	428.789	774.028	836.216	0	836.216
25	4.88918	1790.74	CL1, st	320	28.5	263.612	475.86	287.059	0	287.059

Global Minimum Query (janbu simplified) - Safety Factor: 1.663

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.41362	1254.08	CL3, fm to st	75	26	95.5137	158.839	289.753	117.858	171.895
2	5.11352	3333.79	CH2, st to h	200	20	215.093	357.7	764.07	330.792	433.278
3	5.11352	5494.15	CH2, st to h	200	20	260.327	432.924	1190.23	550.274	639.954
4	5.11352	7627.13	CH2, st to h	200	20	305.62	508.246	1605.97	759.072	846.899
5	5.11352	9567.38	CH2, st to h	200	20	346.046	575.474	1977.75	946.143	1031.61
6	5.11352	11288.1	CH2, st to h	200	20	380.348	632.519	2301.11	1112.77	1188.34
7	5.11352	12775.3	CH2, st to h	200	20	407.942	678.407	2574.33	1259.92	1314.41
8	5.11352	14073.3	CH2, st to h	200	20	430.872	716.54	2807.5	1388.31	1419.19
9	5.11352	15188.7	CH2, st to h	200	20	458.713	762.839	3003.19	1456.8	1546.39
10	5.11352	16124.5	CH2, st to h	200	20	490.203	815.207	3160.99	1470.73	1690.26
11	5.11352	16847.4	CH2, st to h	200	20	515.781	857.744	3273.97	1466.83	1807.14
12	5.11352	17361	CH2, st to h	200	20	535.758	890.966	3343.49	1445.07	1898.42
13	5.11352	17720.1	CH2, st to h	200	20	552.578	918.937	3380.48	1405.23	1975.25
14	5.11352	17921.2	CH2, st to h	200	20	566.218	941.62	3384.52	1346.93	2037.59
15	5.11352	17931.9	CH2, st to h	200	20	575.509	957.072	3349.61	1269.58	2080.03
16	5.11352	17744	CH2, st to h	200	20	580.35	965.122	3274.52	1172.36	2102.16
17	5.11352	17346.5	CH2, st to h	200	20	580.58	965.504	3157.39	1054.19	2103.2
18	5.11352	16724.9	CH2, st to h	200	20	575.969	957.837	2995.74	913.605	2082.14
			CL3, fm to							

			st							
20	4.62186	13424	CL3, fm to st	75	26	611.391	1016.74	2517.95	587.092	1930.86
21	4.29685	11462.8	CH2, st to h	200	20	532.919	886.244	2285.34	399.91	1885.43
22	4.29685	10296.9	CH2, st to h	200	20	511.28	850.259	1981.76	195.189	1786.57
23	4.29685	8903.97	CH2, st to h	200	20	477.69	794.399	1633.1	0	1633.1
24	6.51495	9731.56	CL1, st	320	28.5	554.554	922.224	1109.16	0	1109.16
25	6.51495	3486.27	CL1, st	320	28.5	310.052	515.617	360.281	0	360.281

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.80515

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	311.506	23.8095	0	0	0
2	316.943	20.7389	1114.55	0	0
3	322.817	17.8797	4029.85	0	0
4	328.692	15.4561	7803.74	0	0
5	334.566	13.4362	12066.3	0	0
6	340.44	11.7961	16674.8	0	0
7	346.314	10.5174	21314.1	0	0
8	352.189	9.58676	25682	0	0
9	358.063	8.99494	29516.5	0	0
10	363.937	8.73614	32623.3	0	0
11	369.811	8.80789	34929	0	0
12	375.686	9.21087	36334.4	0	0
13	381.56	9.94895	36746.2	0	0
14	387.434	11.0294	36115.8	0	0
15	393.308	12.4632	34424	0	0
16	399.183	14.2658	31683	0	0
17	405.057	16.4577	27945.1	0	0
18	410.931	19.0661	23310.2	0	0
19	415.904	21.6262	19183.6	0	0
20	420.877	24.5383	14678.9	0	0
21	425.55	27.6269	9925.4	0	0
22	430.222	31.0966	5221.99	0	0
23	434.894	34.998	815.269	0	0
24	439.783	39.6174	-2312.51	0	0
25	444.672	44.8956	-4629.34	0	0
26	449.562	51	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.663

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]

1	321.312	23.8548	0	0	0
2	326.726	20.5648	1470.85	0	0
3	331.84	17.9019	4606.38	0	0
4	336.953	15.6295	8643.44	0	0
5	342.067	13.717	13279.1	0	0
6	347.18	12.141	18167.2	0	0
7	352.294	10.8837	23007	0	0
8	357.407	9.93195	27545.2	0	0
9	362.521	9.2761	31591.7	0	0
10	367.634	8.90983	35039.5	0	0
11	372.748	8.82966	37801.9	0	0
12	377.861	9.03484	39770	0	0
13	382.975	9.52731	40865.6	0	0
14	388.088	10.3118	41042	0	0
15	393.202	11.3959	40270.7	0	0
16	398.315	12.7909	38543.8	0	0
17	403.429	14.5117	35879.1	0	0
18	408.542	16.5785	32324.9	0	0
19	413.656	19.0176	27966	0	0
20	418.278	21.5711	23845.1	0	0
21	422.9	24.4902	19323.2	0	0
22	427.197	27.5705	14575.7	0	0
23	431.493	31.0518	9875.48	0	0
24	435.79	34.998	5485.41	0	0
25	442.305	42.0814	1245.05	0	0
26	448.82	51	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid St_RD_B22B23_RtSlope
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/7/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h
Color						

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 0.520810
Center: 329.418, 62.481
Radius: 36.667
Left Slip Surface Endpoint: 332.492, 25.943
Right Slip Surface Endpoint: 364.326, 51.261
Left Slope Intercept: 332.492 25.943
Right Slope Intercept: 364.326 51.295
Resisting Moment=283286 lb-ft
Driving Moment=543933 lb-ft
Total Slice Area=203.555 ft2

Method: janbu simplified

FS: 0.532154
Center: 329.418, 62.481
Radius: 36.667
Left Slip Surface Endpoint: 332.492, 25.943
Right Slip Surface Endpoint: 364.326, 51.261
Left Slope Intercept: 332.492 25.943
Right Slope Intercept: 364.326 51.295
Resisting Horizontal Force=5650.61 lb
Driving Horizontal Force=10618.4 lb
Total Slice Area=203.555 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 5049
Number of Invalid Surfaces: 13442

Error Codes:

Error Code -103 reported for 6790 surfaces
Error Code -106 reported for 1 surface
Error Code -107 reported for 6365 surfaces
Error Code -108 reported for 40 surfaces
Error Code -112 reported for 246 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4968
Number of Invalid Surfaces: 13523

Error Codes:

Error Code -103 reported for 6790 surfaces
Error Code -106 reported for 1 surface
Error Code -107 reported for 6365 surfaces
Error Code -108 reported for 88 surfaces
Error Code -111 reported for 7 surfaces
Error Code -112 reported for 272 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.52081

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.16221	67.6697	CL3, fm to st	75	26	156.796	81.6609	42.6584	29.0016	13.6568
2	1.16221	204.354	CL3, fm to st	75	26	203.288	105.875	149.134	85.8319	63.3021
3	1.16221	337.47	CL3, fm to st	75	26	246.701	128.484	249.959	140.301	109.658
4	1.16221	465.008	CL3, fm to st	75	26	285.864	148.881	343.852	192.375	151.477
5	1.23664	627.383	CH1 (weathered), v/st to h	50	17	220.854	115.023	456.199	243.518	212.681
6	1.23664	754.899	CH1 (weathered), v/st to h	50	17	243.691	126.917	545.093	293.51	251.583
7	1.23664	867.173	CH1 (weathered), v/st to h	50	17	262.858	136.899	620.827	336.592	284.235
8	1.23664	970.44	CH1 (weathered), v/st to h	50	17	279.056	145.335	688.501	376.675	311.826
			CH1 (weathered),							

			v/st to h							
10	1.23664	1147.09	CH1 (weathered), v/st to h	50	17	302.056	157.314	798.441	447.435	351.006
11	1.23664	1218.91	CH1 (weathered), v/st to h	50	17	308.631	160.738	840.043	477.838	362.205
12	1.23664	1281.6	CH1 (weathered), v/st to h	50	17	312.87	162.946	874.131	504.699	369.432
13	1.23664	1333.79	CH1 (weathered), v/st to h	50	17	314.447	163.767	899.924	527.811	372.113
14	1.36674	1513.69	CH2, st to h	200	20	539.823	281.145	770.643	547.697	222.946
15	1.36674	1537.85	CH2, st to h	200	20	524.452	273.14	764.495	563.548	200.947
16	1.36674	1546.67	CH2, st to h	200	20	506	263.53	748.188	573.641	174.547
17	1.36674	1546.96	CH2, st to h	200	20	487.028	253.649	724.758	577.36	147.398
18	1.31336	1472.87	CL3, fm to st	75	26	352.271	183.466	796.521	574.134	222.387
19	1.31336	1437.03	CL3, fm to st	75	26	327.951	170.8	759.715	563.296	196.419
20	1.31336	1378.15	CL3, fm to st	75	26	299.463	155.964	709.7	543.7	166
21	1.3297	1312.82	CL1, st	320	28.5	476.279	248.051	380.886	513.4	-132.514
22	1.3297	1201.2	CL1, st	320	28.5	424.714	221.195	287.773	469.748	-181.975
23	1.3297	1045.56	CL1, st	320	28.5	365.715	190.468	170.315	408.883	-238.568
24	1.3297	777.01	CL1, st	320	28.5	353.25	183.976	55.7109	306.236	-250.525
25	1.3297	283.761	CL1, st	320	28.5	263.286	137.122	-225.13	111.69	-336.82

Global Minimum Query (janbu simplified) - Safety Factor: 0.532154

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.16221	67.6697	CL3, fm to st	75	26	153.694	81.7891	42.9212	29.0016	13.9196
2	1.16221	204.354	CL3, fm to st	75	26	199.357	106.089	149.573	85.8319	63.7413
3	1.16221	337.47	CL3, fm to st	75	26	242.035	128.8	250.607	140.301	110.306
4	1.16221	465.008	CL3, fm to st	75	26	280.575	149.309	344.731	192.375	152.356
5	1.23664	627.383	CH1 (weathered), v/st to h	50	17	216.624	115.277	457.031	243.518	213.513
6	1.23664	754.899	CH1 (weathered), v/st to h	50	17	239.095	127.235	546.136	293.51	252.626
7	1.23664	867.173	CH1 (weathered), v/st to h	50	17	257.979	137.284	622.087	336.592	285.495
8	1.23664	970.44	CH1 (weathered), v/st to h	50	17	273.957	145.787	689.981	376.675	313.306
9	1.23664	1065.3	CH1 (weathered), v/st to h	50	17	287.402	152.942	750.372	413.665	336.707
10	1.23664	1147.09	CH1 (weathered), v/st to h	50	17	296.715	157.898	800.356	447.435	352.921
11	1.23664	1218.91	CH1 (weathered), v/st to h	50	17	303.264	161.383	842.153	477.838	364.315
12	1.23664	1281.6	CH1 (weathered), v/st to h	50	17	307.522	163.649	876.431	504.699	371.732
13	1.23664	1333.79	CH1 (weathered), v/st to h	50	17	309.168	164.525	902.407	527.811	374.596

14	1.36674	1513.69	CH2, st to h	200	20	531.289	282.727	774.989	547.697	227.292
15	1.36674	1537.85	CH2, st to h	200	20	516.36	274.783	769.015	563.548	205.467
16	1.36674	1546.67	CH2, st to h	200	20	498.393	265.222	752.838	573.641	179.197
17	1.36674	1546.96	CH2, st to h	200	20	479.906	255.384	729.529	577.36	152.169
18	1.31336	1472.87	CL3, fm to st	75	26	347.73	185.046	799.764	574.134	225.63
19	1.31336	1437.03	CL3, fm to st	75	26	323.875	172.351	762.898	563.296	199.602
20	1.31336	1378.15	CL3, fm to st	75	26	295.888	157.458	712.761	543.7	169.061
21	1.3297	1312.82	CL1, st	320	28.5	471.076	250.685	385.738	513.4	-127.662
22	1.3297	1201.2	CL1, st	320	28.5	420.321	223.675	292.34	469.748	-177.408
23	1.3297	1045.56	CL1, st	320	28.5	362.17	192.73	174.482	408.883	-234.401
24	1.3297	777.01	CL1, st	320	28.5	350.098	186.306	60.0025	306.236	-246.234
25	1.3297	283.761	CL1, st	320	28.5	261.195	138.996	-221.678	111.69	-333.368

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.52081

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	332.492	25.943	0	0	0
2	333.654	26.0595	175.594	0	0
3	334.817	26.2135	386.72	0	0
4	335.979	26.4057	622.789	0	0
5	337.141	26.6365	872.613	0	0
6	338.378	26.9254	1011.42	0	0
7	339.614	27.2601	1127.57	0	0
8	340.851	27.6419	1212.64	0	0
9	342.088	28.0723	1258.22	0	0
10	343.324	28.5532	1256.78	0	0
11	344.561	29.0868	1200.84	0	0
12	345.798	29.6757	1084.35	0	0
13	347.034	30.3228	902.032	0	0
14	348.271	31.0319	649.265	0	0
15	349.638	31.8926	716.942	0	0
16	351.004	32.8413	701.898	0	0
17	352.371	33.8867	605.036	0	0
18	353.738	35.0397	428.929	0	0
19	355.051	36.2623	-86.4967	0	0
20	356.365	37.6141	-686.68	0	0
21	357.678	39.1174	-1363.88	0	0
22	359.008	40.8261	-1387.18	0	0
23	360.337	42.7712	-1387.36	0	0
24	361.667	45.0316	-1290.5	0	0
25	362.997	47.7517	-980.791	0	0
26	364.326	51.2612	0.0354662	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.532154

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	332.492	25.943	0	0	0
2	333.654	26.0595	172.515	0	0
3	334.817	26.2135	379.725	0	0
4	335.979	26.4057	611.119	0	0
5	337.141	26.6365	855.604	0	0
6	338.378	26.9254	989.768	0	0
7	339.614	27.2601	1100.81	0	0
8	340.851	27.6419	1180.35	0	0
9	342.088	28.0723	1220.04	0	0
10	343.324	28.5532	1212.37	0	0
11	344.561	29.0868	1149.94	0	0
12	345.798	29.6757	1026.73	0	0
13	347.034	30.3228	837.487	0	0
14	348.271	31.0319	577.613	0	0
15	349.638	31.8926	632.116	0	0
16	351.004	32.8413	603.898	0	0
17	352.371	33.8867	493.868	0	0
18	353.738	35.0397	304.541	0	0
19	355.051	36.2623	-219.417	0	0
20	356.365	37.6141	-827.959	0	0
21	357.678	39.1174	-1513.28	0	0
22	359.008	40.8261	-1549.89	0	0
23	360.337	42.7712	-1563.11	0	0
24	361.667	45.0316	-1478.93	0	0
25	362.997	47.7517	-1183.68	0	0
26	364.326	51.2612	0.0354662	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid_RD_B22B23_RtSlope_2H1V
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/7/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 0.865074
Center: 347.508, 75.170
Radius: 54.165
Left Slip Surface Endpoint: 328.594, 24.415
Right Slip Surface Endpoint: 396.218, 51.479
Resisting Moment=1.70656e+006 lb-ft
Driving Moment=1.97273e+006 lb-ft
Total Slice Area=829.641 ft2

Method: janbu simplified

FS: 0.786120
Center: 347.508, 75.170
Radius: 54.165
Left Slip Surface Endpoint: 328.594, 24.415
Right Slip Surface Endpoint: 396.218, 51.479
Resisting Horizontal Force=26686.4 lb
Driving Horizontal Force=33947 lb
Total Slice Area=829.641 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.865074

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.58434	176.621	CL3, fm to st	75	26	131.518	113.773	113.451	33.955	79.496
2	2.58434	705.27	CL3, fm to st	75	26	195.507	169.128	329.223	136.232	192.991
3	2.58434	1345.67	CL3, fm to st	75	26	269.962	233.537	584.279	259.229	325.05
4	2.58434	1954.86	CL3, fm to st	75	26	337.542	291.999	818.778	373.863	444.915

5	2.58434	2523.04	CL3, fm to st	75	26	396.531	343.029	1029.93	480.389	549.541
6	2.58434	3050.21	CL3, fm to st	75	26	447.611	387.217	1219.14	578.994	640.141
7	2.58434	3528.64	CL3, fm to st	75	26	489.632	423.568	1384.47	669.806	714.669
8	2.58434	3948.99	CL3, fm to st	75	26	521.2	450.877	1523.56	752.894	770.664
9	2.58434	4328.79	CL3, fm to st	75	26	546.747	472.977	1644.25	828.277	815.974
10	2.58434	4660.32	CL3, fm to st	75	26	565.055	488.814	1744.36	895.917	848.446
11	2.58434	4942.6	CL3, fm to st	75	26	576.4	498.629	1824.3	955.725	868.57
12	2.58434	5183.58	CL3, fm to st	75	26	582.815	504.178	1887.5	1007.55	879.947
13	2.58434	5375.05	CL3, fm to st	75	26	583.066	504.395	1931.58	1051.19	880.387
14	2.58434	5530.19	CL3, fm to st	75	26	580.068	501.802	1961.42	1086.35	875.069
15	2.58434	5649.4	CL3, fm to st	75	26	574.167	496.697	1977.27	1112.67	864.604
16	2.58434	5720.45	CL3, fm to st	75	26	563.488	487.459	1975.35	1129.68	845.667
17	2.76395	6143.74	CH2, st to h	200	20	570.927	493.894	1944.14	1136.68	807.464
18	2.76395	6111.33	CH2, st to h	200	20	554.228	479.448	1899.86	1132.08	767.776
19	2.76395	6006.61	CH2, st to h	200	20	532.741	460.86	1830.8	1114.1	716.702
20	2.76395	5821.23	CH2, st to h	200	20	506.116	437.828	1734.61	1081.19	653.425
21	2.76395	5543.94	CH2, st to h	200	20	473.887	409.947	1608.1	1031.27	576.828
22	4.04788	7081.88	CL3, fm to st	75	26	380.966	329.564	1430.7	908.768	521.934
23	2.80233	3643.76	CL1, st	320	28.5	523.238	452.64	919.883	675.59	244.293
24	2.80233	2388.31	CL1, st	320	28.5	411.604	356.068	509.072	442.642	66.4297
25	2.80233	852.348	CL1, st	320	28.5	290.71	251.486	31.4559	157.643	-126.187

Global Minimum Query (janbu simplified) - Safety Factor: 0.78612

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.58434	176.621	CL3, fm to st	75	26	148.352	116.622	119.293	33.955	85.338
2	2.58434	705.27	CL3, fm to st	75	26	219.48	172.538	336.214	136.232	199.982
3	2.58434	1345.67	CL3, fm to st	75	26	301.783	237.238	591.867	259.229	332.638
4	2.58434	1954.86	CL3, fm to st	75	26	375.897	295.5	825.954	373.863	452.091
5	2.58434	2523.04	CL3, fm to st	75	26	440.06	345.94	1035.9	480.389	555.511

6	2.58434	3050.21	CL3, fm to st	75	26	495.165	389.259	1223.32	578.994	644.328
7	2.58434	3528.64	CL3, fm to st	75	26	540.046	424.541	1386.47	669.806	716.664
8	2.58434	3948.99	CL3, fm to st	75	26	573.265	450.655	1523.1	752.894	770.208
9	2.58434	4328.79	CL3, fm to st	75	26	599.781	471.5	1641.22	828.277	812.945
10	2.58434	4660.32	CL3, fm to st	75	26	618.306	486.063	1738.72	895.917	842.804
11	2.58434	4942.6	CL3, fm to st	75	26	629.198	494.625	1816.08	955.725	860.359
12	2.58434	5183.58	CL3, fm to st	75	26	634.708	498.957	1876.79	1007.55	869.243
13	2.58434	5375.05	CL3, fm to st	75	26	633.531	498.031	1918.53	1051.19	867.336
14	2.58434	5530.19	CL3, fm to st	75	26	628.854	494.355	1946.15	1086.35	859.8
15	2.58434	5649.4	CL3, fm to st	75	26	621.068	488.234	1959.92	1112.67	847.25
16	2.58434	5720.45	CL3, fm to st	75	26	608.155	478.083	1956.13	1129.68	826.445
17	2.76395	6143.74	CH2, st to h	200	20	617.546	485.465	1920.99	1136.68	784.307
18	2.76395	6111.33	CH2, st to h	200	20	598.241	470.289	1874.69	1132.08	742.611
19	2.76395	6006.61	CH2, st to h	200	20	573.799	451.075	1803.92	1114.1	689.822
20	2.76395	5821.23	CH2, st to h	200	20	543.869	427.546	1706.37	1081.19	625.178
21	2.76395	5543.94	CH2, st to h	200	20	507.972	399.327	1578.92	1031.27	547.652
22	4.04788	7081.88	CL3, fm to st	75	26	404.389	317.898	1406.78	908.768	498.014
23	2.80233	3643.76	CL1, st	320	28.5	551.586	433.613	884.839	675.59	209.249
24	2.80233	2388.31	CL1, st	320	28.5	432.033	339.63	478.795	442.642	36.1535
25	2.80233	852.348	CL1, st	320	28.5	303.509	238.595	7.71294	157.643	-149.93

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.865074

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	328.594	24.4149	0	0	0
2	331.178	23.5254	439.611	0	0
3	333.762	22.7783	1189.07	0	0
4	336.347	22.1675	2241.14	0	0
5	338.931	21.6885	3502.65	0	0
6	341.515	21.3376	4885.22	0	0
7	344.1	21.1124	6312.49	0	0
8	346.684	21.0113	7713.39	0	0
9	349.268	21.0336	9021.61	0	0

10	351.853	21.1795	10189.7	0	0
11	354.437	21.45	11173.1	0	0
12	357.021	21.8469	11933.3	0	0
13	359.606	22.3732	12440.9	0	0
14	362.19	23.0327	12668.5	0	0
15	364.774	23.8306	12597.4	0	0
16	367.359	24.7735	12211.8	0	0
17	369.943	25.8696	11497.7	0	0
18	372.707	27.2234	10438.1	0	0
19	375.471	28.781	9005.45	0	0
20	378.235	30.5637	7209.06	0	0
21	380.999	32.5997	5071.35	0	0
22	383.763	34.9274	2633.24	0	0
23	387.811	38.982	-1632.06	0	0
24	390.613	42.37	-3290.73	0	0
25	393.415	46.4228	-4207.73	0	0
26	396.218	51.4792	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.78612

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	328.594	24.4149	0	0	0
2	331.178	23.5254	488.67	0	0
3	333.762	22.7783	1305.84	0	0
4	336.347	22.1675	2445.54	0	0
5	338.931	21.6885	3810.56	0	0
6	341.515	21.3376	5308.84	0	0
7	344.1	21.1124	6861.23	0	0
8	346.684	21.0113	8394.02	0	0
9	349.268	21.0336	9838.3	0	0
10	351.853	21.1795	11145.5	0	0
11	354.437	21.45	12269.7	0	0
12	357.021	21.8469	13171.3	0	0
13	359.606	22.3732	13820.3	0	0
14	362.19	23.0327	14188.7	0	0
15	364.774	23.8306	14257.6	0	0
16	367.359	24.7735	14011.2	0	0
17	369.943	25.8696	13435.4	0	0
18	372.707	27.2234	12537.8	0	0
19	375.471	28.781	11267.8	0	0
20	378.235	30.5637	9634.51	0	0
21	380.999	32.5997	7660.29	0	0
22	383.763	34.9274	5385.86	0	0
23	387.811	38.982	1314.2	0	0
24	390.613	42.37	-144.527	0	0
25	393.415	46.4228	-880.162	0	0

26	396.218	51.4792	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid_RD_B22B23_RtSlope_3H1V
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/7/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 1.201590
Center: 359.568, 94.204
Radius: 77.682
Left Slip Surface Endpoint: 325.882, 24.206
Right Slip Surface Endpoint: 424.127, 51.000
Resisting Moment=4.34692e+006 lb-ft
Driving Moment=3.61766e+006 lb-ft
Total Slice Area=1458.31 ft2

Method: janbu simplified

FS: 1.075530
Center: 359.568, 75.170
Radius: 62.759
Left Slip Surface Endpoint: 323.229, 24.002
Right Slip Surface Endpoint: 417.486, 51.000
Resisting Horizontal Force=51462.2 lb
Driving Horizontal Force=47848.4 lb
Total Slice Area=1626.11 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.20159

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.05187	537.123	CL3, fm to st	75	26	109.271	131.298	181.443	66.0144	115.429
2	4.05187	1686.35	CL3, fm to st	75	26	174.967	210.239	482.869	205.588	277.281
3	4.06713	3077.79	CH2, st to h	200	20	311.062	373.769	855.923	378.496	477.427
4	4.06713	4372.94	CH2, st to h	200	20	357.802	429.931	1168.09	536.361	631.73
5	4.06713	5556.34	CH2, st to h	200	20	398.947	479.371	1447.11	679.542	767.564

6	4.06713	6607.29	CH2, st to h	200	20	433.022	520.315	1688.64	808.58	880.06
7	4.06713	7523.89	CH2, st to h	200	20	460.105	552.857	1893.33	923.867	969.467
8	4.06713	8333.13	CH2, st to h	200	20	482.455	579.713	2068.92	1025.66	1043.26
9	4.06713	9036.23	CH2, st to h	200	20	500.294	601.148	2216.26	1114.12	1102.14
10	4.06713	9604.14	CH2, st to h	200	20	511.64	614.781	2328.86	1189.26	1139.6
11	4.06713	10039.5	CH2, st to h	200	20	516.94	621.15	2408.11	1251.01	1157.1
12	4.06713	10374.3	CH2, st to h	200	20	518.718	623.286	2462.14	1299.17	1162.97
13	4.06713	10631.7	CH2, st to h	200	20	518.765	623.343	2496.58	1333.44	1163.14
14	4.06713	10778.6	CH2, st to h	200	20	514.944	618.751	2503.86	1353.36	1150.5
15	4.24699	11272.5	CL3, fm to st	75	26	516.07	620.104	2475.71	1358.07	1117.64
16	4.24699	11138.7	CL3, fm to st	75	26	497.28	597.527	2417.35	1346.02	1071.33
17	4.24699	10848.3	CL3, fm to st	75	26	472.254	567.456	2325.25	1315.57	1009.68
18	3.54221	8718.43	CH2, st to h	200	20	450.929	541.832	2210.14	1270.96	939.176
19	3.54221	8314.36	CH2, st to h	200	20	428.213	514.536	2078.01	1213.84	864.174
20	3.54221	7794.86	CH2, st to h	200	20	401.559	482.509	1916.23	1140.04	776.191
21	3.54221	7146.37	CH2, st to h	200	20	370.68	445.405	1721.87	1047.62	674.247
22	3.60664	6276.16	CL1, st	320	28.5	526.352	632.459	1481.08	905.606	575.478
23	3.60664	4779.75	CL1, st	320	28.5	455.573	547.412	1107.98	689.137	418.84
24	3.60664	3062.52	CL1, st	320	28.5	367.662	441.779	665.838	441.549	224.289
25	3.60664	1072.19	CL1, st	320	28.5	273.608	328.765	170.729	154.586	16.1431

Global Minimum Query (janbu simplified) - Safety Factor: 1.07553

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.73089	1009.49	CL3, fm to st	75	26	167.351	179.991	321.66	106.397	215.263
2	3.84155	2204.75	CH2, st to h	200	20	346.451	372.618	760.733	286.47	474.263
3	3.84155	3563.1	CH2, st to h	200	20	403.68	434.17	1110.72	467.339	643.379
4	3.84155	4930.67	CH2, st to h	200	20	460.114	494.866	1456.48	646.342	810.137
5	3.84155	6179.87	CH2, st to h	200	20	509.458	547.937	1763.35	807.399	955.95
6	3.84155	7302.61	CH2, st to h	200	20	551.091	592.715	2030.64	951.664	1078.97
7	3.84155	8279.27	CH2, st to h	200	20	583.387	627.45	2254.39	1079.98	1174.41
8	3.84155	9127.51	CH2, st to h	200	20	608.295	654.239	2440.96	1192.94	1248.02
9	3.84155	9863.38	CH2, st to h	200	20	627.479	674.873	2595.65	1290.95	1304.7
10	3.84155	10488.4	CH2, st to h	200	20	641.226	689.658	2719.51	1374.2	1345.31
11	3.84155	10975.7	CH2, st to h	200	20	647.409	696.308	2806.32	1442.74	1363.58
12	3.84155	11329.3	CH2, st to h	200	20	646.714	695.56	2857.97	1496.43	1361.54
13	3.84155	11573.3	CH2, st to h	200	20	641.46	689.91	2880.99	1534.97	1346.02
14	3.84155	11729.5	CH2, st to h	200	20	633.695	681.558	2880.94	1557.87	1323.07
15	3.84155	11768.3	CH2, st to h	200	20	621.267	668.191	2850.74	1564.39	1286.35
16	3.84155	11676.6	CH2, st to h	200	20	603.561	649.148	2787.55	1553.53	1234.02
17	3.84155	11444.2	CH2, st to h	200	20	580.339	624.172	2689.34	1523.94	1165.4
			CL3, fm to st							

19	4.12396	11136.5	CL3, fm to st	75	26	503.021	541.014	2345.87	1390.4	955.47
20	3.33576	8344.59	CH2, st to h	200	20	465.542	500.704	2118.43	1292.25	826.183
21	3.33576	7590.61	CH2, st to h	200	20	421.861	453.724	1874.89	1177.79	697.103
22	3.33576	6645.1	CH2, st to h	200	20	371.229	399.268	1581.45	1033.97	547.48
23	3.26854	5363.09	CL1, st	320	28.5	435.551	468.448	1128.42	855.013	273.408
24	3.26854	3638.58	CL1, st	320	28.5	384.63	413.681	751.41	578.871	172.539
25	3.26854	1311.28	CL1, st	320	28.5	255.824	275.146	126.005	208.615	-82.6099

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.20159

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	325.882	24.2063	0	0	0
2	329.934	22.397	771.837	0	0
3	333.986	20.8556	2226.32	0	0
4	338.053	19.5613	4601.62	0	0
5	342.12	18.5072	7290.75	0	0
6	346.187	17.6834	10108.3	0	0
7	350.254	17.0827	12887.1	0	0
8	354.321	16.6996	15487	0	0
9	358.388	16.5312	17801.3	0	0
10	362.455	16.5759	19740.6	0	0
11	366.523	16.8341	21223.9	0	0
12	370.59	17.308	22188.9	0	0
13	374.657	18.0017	22594.6	0	0
14	378.724	18.9211	22413	0	0
15	382.791	20.0746	21622.7	0	0
16	387.038	21.5413	20187.5	0	0
17	391.285	23.292	18071	0	0
18	395.532	25.3486	15298.3	0	0
19	399.074	27.318	12545.8	0	0
20	402.616	29.5409	9446.14	0	0
21	406.159	32.0445	6073.58	0	0
22	409.701	34.8644	2533.53	0	0
23	413.308	38.1098	-371.374	0	0
24	416.914	41.8025	-2816.75	0	0
25	420.521	46.0453	-4313.36	0	0
26	424.127	51	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.07553

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[ft]	[ft]	[lbs]	[lbs]	[degrees]
1	323.229	24.0023	0	0	0
2	327.96	20.9521	1775.64	0	0
3	331.802	18.8879	4681.5	0	0
4	335.643	17.1506	8167.35	0	0
5	339.485	15.7116	12037.1	0	0
6	343.327	14.5495	16050.3	0	0
7	347.168	13.6486	20004.1	0	0
8	351.01	12.9977	23720.5	0	0
9	354.851	12.5889	27063.4	0	0
10	358.693	12.4175	29927.3	0	0
11	362.534	12.4815	32225.1	0	0
12	366.376	12.7817	33878.6	0	0
13	370.217	13.3215	34829	0	0
14	374.059	14.1072	35038.2	0	0
15	377.901	15.1486	34481.1	0	0
16	381.742	16.4591	33140	0	0
17	385.584	18.0574	31011.5	0	0
18	389.425	19.9685	28109.3	0	0
19	393.549	22.4069	24210.3	0	0
20	397.673	25.3035	19496.9	0	0
21	401.009	28.0391	15260.2	0	0
22	404.345	31.1959	10753.8	0	0
23	407.68	34.8727	6181.72	0	0
24	410.949	39.1328	2803.13	0	0
25	414.217	44.3136	171.841	0	0
26	417.486	51	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Enid_RD_B22B23_RtSlope_4H1V
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Enid St_Rapid Drawdown Condition (B-22 and B-23)
Author: PST
Company: ATL
Date Created: 5/7/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h

Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122
Cohesion [psf]	320	320	50	75	200	200
Friction Angle [deg]	28.5	28.5	17	26	20	22
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 1.443590
Center: 371.628, 113.238
Radius: 102.077
Left Slip Surface Endpoint: 322.205, 23.923
Right Slip Surface Endpoint: 452.537, 51.000
Resisting Moment=8.67833e+006 lb-ft
Driving Moment=6.01164e+006 lb-ft
Total Slice Area=2380.75 ft2

Method: janbu simplified

FS: 1.302330
Center: 371.628, 100.549
Radius: 91.726
Left Slip Surface Endpoint: 321.312, 23.855
Right Slip Surface Endpoint: 448.820, 51.000
Resisting Horizontal Force=78745.4 lb
Driving Horizontal Force=60465.2 lb
Total Slice Area=2515.93 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.44359

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	6.26294	1436.92	CL3, fm to st	75	26	109.673	158.323	285.369	114.532	170.837
2	5.19791	3306.57	CH2, st to h	200	20	247.178	356.824	743.39	312.518	430.872
3	5.19791	5406.02	CH2, st to h	200	20	296.358	427.82	1149.71	523.779	625.931
4	5.19791	7391.73	CH2, st to h	200	20	343.679	496.132	1528.59	714.969	813.616
5	5.19791	9198.83	CH2, st to h	200	20	385.637	556.701	1867.2	887.167	980.035
6	5.19791	10783.6	CH2, st to h	200	20	420.042	606.368	2157.69	1041.21	1116.48

7	5.19791	12170	CH2, st to h	200	20	448.257	647.1	2406.12	1177.72	1228.4
8	5.19791	13383	CH2, st to h	200	20	471.634	680.846	2618.27	1297.16	1321.11
9	5.19791	14425.8	CH2, st to h	200	20	490.405	707.944	2795.42	1399.85	1395.57
10	5.19791	15291.1	CH2, st to h	200	20	504.321	728.033	2936.73	1485.96	1450.77
11	5.19791	15937.6	CH2, st to h	200	20	511.532	738.442	3034.88	1555.52	1479.36
12	5.19791	16414.1	CH2, st to h	200	20	514.557	742.809	3099.8	1608.44	1491.36
13	5.19791	16760.1	CH2, st to h	200	20	515.4	744.026	3139.2	1644.51	1494.69
14	5.19791	16937.7	CH2, st to h	200	20	512.424	739.73	3146.23	1663.34	1482.89
15	5.19791	16934.7	CH2, st to h	200	20	505.299	729.444	3119.06	1664.42	1454.64
16	5.19791	16744.2	CH2, st to h	200	20	493.97	713.09	3056.75	1647.05	1409.7
17	5.19791	16356.7	CH2, st to h	200	20	478.341	690.529	2957.99	1610.28	1347.71
18	5.35258	16196	CL3, fm to st	75	26	475.823	686.894	2806.34	1551.76	1254.58
19	5.35258	15273.4	CL3, fm to st	75	26	440.149	635.395	2618.23	1469.24	1148.99
20	4.9499	13092	CH2, st to h	200	20	399.352	576.5	2400.58	1366.16	1034.42
21	4.9499	11877.9	CH2, st to h	200	20	366.286	528.767	2145.25	1241.97	903.279
22	4.9499	10395.6	CH2, st to h	200	20	334.19	482.433	1866.59	1090.61	775.983
23	5.11582	8415.14	CL1, st	320	28.5	457.929	661.062	1483.52	855.361	628.159
24	5.11582	5387.26	CL1, st	320	28.5	364.284	525.877	926.768	547.591	379.177
25	5.11582	1883.93	CL1, st	320	28.5	263.215	379.975	301.953	191.493	110.46

Global Minimum Query (janbu simplified) - Safety Factor: 1.30233

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.0501	1096.29	CL3, fm to st	75	26	127.417	165.939	294.821	108.368	186.453
2	5.1651	3230.56	CH2, st to h	200	20	282.06	367.335	773.657	313.907	459.75
3	5.1651	5418.93	CH2, st to h	200	20	341.609	444.888	1202.16	529.34	672.824
4	5.1651	7605.67	CH2, st to h	200	20	399.519	520.306	1623	742.965	880.034
5	5.1651	9593.46	CH2, st to h	200	20	450.582	586.807	1997.1	934.353	1062.74
6	5.1651	11356.6	CH2, st to h	200	20	493.358	642.515	2320.64	1104.84	1215.8
7	5.1651	12878.4	CH2, st to h	200	20	527.058	686.404	2591.82	1255.43	1336.39
8	5.1651	14204.9	CH2, st to h	200	20	554.479	722.114	2821.37	1386.87	1434.5
9	5.1651	15343.1	CH2, st to h	200	20	576.119	750.297	3011.6	1499.67	1511.93
10	5.1651	16296.1	CH2, st to h	200	20	592.264	771.323	3163.83	1594.14	1569.69
11	5.1651	17029	CH2, st to h	200	20	601.177	782.931	3272.01	1670.42	1601.59
12	5.1651	17547.7	CH2, st to h	200	20	603.43	785.865	3338.12	1728.47	1609.65
13	5.1651	17908.7	CH2, st to h	200	20	602.23	784.302	3373.42	1768.07	1605.35
14	5.1651	18104.5	CH2, st to h	200	20	597.349	777.946	3376.69	1788.81	1587.88
15	5.1651	18103.5	CH2, st to h	200	20	587.446	765.049	3342.53	1790.08	1552.45
16	5.1651	17897.2	CH2, st to h	200	20	572.447	745.515	3269.79	1771.01	1498.78
17	5.1651	17474	CH2, st to h	200	20	552.217	719.169	3156.85	1730.46	1426.39
18	5.1651	16818.4	CH2, st to h	200	20	526.557	685.751	3001.47	1666.89	1334.58
19	4.46983	13818.9	CL3, fm to st	75	26	513.89	669.255	2804.37	1585.97	1218.4

20	4.46983	12923.1	CL3, fm to st	75	26	470.669	612.967	2591.85	1488.85	1103
21	6.34066	16409.4	CH2, st to h	200	20	416.664	542.634	2278.78	1337.41	941.375
22	6.34066	13606	CH2, st to h	200	20	354.092	461.145	1830.38	1112.89	717.487
23	4.3433	7143.76	CL1, st	320	28.5	458.858	597.585	1367.71	856.462	511.249
24	4.3433	4596.47	CL1, st	320	28.5	373.434	486.334	856.658	550.31	306.348
25	4.3433	1612.96	CL1, st	320	28.5	266.261	346.759	242.395	193.111	49.2843

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.44359

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	322.205	23.9235	0	0	0
2	328.468	20.7343	1598.08	0	0
3	333.666	18.4825	4558.95	0	0
4	338.864	16.5621	8309.85	0	0
5	344.062	14.9536	12557.9	0	0
6	349.26	13.6419	17014.9	0	0
7	354.458	12.6154	21416.6	0	0
8	359.655	11.8655	25554.9	0	0
9	364.853	11.3859	29265.9	0	0
10	370.051	11.1731	32414.3	0	0
11	375.249	11.2251	34887.1	0	0
12	380.447	11.5425	36587.1	0	0
13	385.645	12.1278	37451.8	0	0
14	390.843	12.9856	37442.3	0	0
15	396.041	14.1231	36531.6	0	0
16	401.239	15.5499	34712	0	0
17	406.437	17.279	31998.3	0	0
18	411.634	19.3271	28430.3	0	0
19	416.987	21.7922	24063.5	0	0
20	422.34	24.6485	18945.1	0	0
21	427.29	27.6718	13667.3	0	0
22	432.239	31.1037	8120.96	0	0
23	437.189	34.998	2508.89	0	0
24	442.305	39.5866	-1951.85	0	0
25	447.421	44.8624	-4974.67	0	0
26	452.537	51	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.30233

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	321.312	23.8548	0	0	0

2	326.363	20.7699	1552.16	0	0
3	331.528	18.0528	5109.38	0	0
4	336.693	15.7363	9656.47	0	0
5	341.858	13.7884	14879	0	0
6	347.023	12.1846	20406.3	0	0
7	352.188	10.9066	25917.3	0	0
8	357.353	9.94045	31140.3	0	0
9	362.518	9.27635	35874.3	0	0
10	367.683	8.9077	39956.6	0	0
11	372.848	8.83094	43254.8	0	0
12	378.014	9.04534	45654.6	0	0
13	383.179	9.55295	47073.1	0	0
14	388.344	10.3587	47461.6	0	0
15	393.509	11.4708	46788.2	0	0
16	398.674	12.9007	45039.1	0	0
17	403.839	14.6644	42225.2	0	0
18	409.004	16.783	38385.8	0	0
19	414.169	19.2843	33594.8	0	0
20	418.639	21.7856	28874.4	0	0
21	423.109	24.6317	23598.9	0	0
22	429.45	29.3423	15503	0	0
23	435.79	34.998	7393.42	0	0
24	440.134	39.5513	3156.34	0	0
25	444.477	44.8105	270.906	0	0
26	448.82	51	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_ST_B22B24_RtSlope
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd. _Short Term Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered),	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

			v/st to h				
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	1000	1000	500	750	1250	2000	50
Friction Angle [deg]	0	0	0	3	0	0	24
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	None
Hu Value			1	1	1	1	
Ru Value	0	0					0

Global Minimums

Method: bishop simplified

FS: 1.548650
Center: 329.418, 208.408
Radius: 181.292
Left Slip Surface Endpoint: 408.549, 45.297
Right Slip Surface Endpoint: 414.498, 48.320
Resisting Moment=138715 lb-ft
Driving Moment=89571.3 lb-ft
Total Slice Area=3.85187 ft2

Method: janbu simplified

FS: 1.546380
Center: 341.478, 176.685
Radius: 147.454
Left Slip Surface Endpoint: 408.743, 45.467
Right Slip Surface Endpoint: 414.034, 48.316
Resisting Horizontal Force=561.892 lb
Driving Horizontal Force=363.359 lb
Total Slice Area=2.97694 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.54865

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.237959	1.30451	CL w/shell	50	24	29.707	46.0058	-8.97116	0	-8.97116
2	0.237959	3.9074	CL w/shell	50	24	32.4511	50.2553	0.573512	0	0.573512

3	0.237959	6.49801	CL w/shell	50	24	35.1796	54.4808	10.0641	0	10.0641
4	0.237959	9.0763	CL w/shell	50	24	37.8925	58.6822	19.5006	0	19.5006
5	0.237959	11.6423	CL w/shell	50	24	40.5899	62.8595	28.8829	0	28.8829
6	0.237959	14.1958	CL w/shell	50	24	43.2716	67.0126	38.2111	0	38.2111
7	0.237959	16.737	CL w/shell	50	24	45.9378	71.1416	47.4849	0	47.4849
8	0.237959	19.2658	CL w/shell	50	24	48.5884	75.2464	56.7043	0	56.7043
9	0.237959	21.7822	CL w/shell	50	24	51.2233	79.327	65.8695	0	65.8695
10	0.237959	24.286	CL w/shell	50	24	53.8426	83.3833	74.9801	0	74.9801
11	0.237959	26.7774	CL w/shell	50	24	56.4462	87.4154	84.0364	0	84.0364
12	0.237959	29.2562	CL w/shell	50	24	59.0341	91.4231	93.0381	0	93.0381
13	0.237959	31.7225	CL w/shell	50	24	61.6063	95.4066	101.985	0	101.985
14	0.237959	34.1762	CL w/shell	50	24	64.1628	99.3657	110.877	0	110.877
15	0.237959	35.8965	CL w/shell	50	24	97.0239	150.256	225.178	0	225.178
16	0.237959	33.211	CL w/shell	50	24	125.706	194.675	324.945	0	324.945
17	0.237959	29.7693	CL w/shell	50	24	122.026	188.976	312.145	0	312.145
18	0.237959	26.3148	CL w/shell	50	24	118.337	183.262	299.31	0	299.31
19	0.237959	22.8476	CL w/shell	50	24	114.636	177.531	286.44	0	286.44
20	0.237959	19.3676	CL w/shell	50	24	110.926	171.786	273.535	0	273.535
21	0.237959	15.8748	CL w/shell	50	24	107.206	166.025	260.595	0	260.595
22	0.237959	12.3693	CL w/shell	50	24	103.476	160.248	247.621	0	247.621
23	0.237959	8.85084	CL w/shell	50	24	99.7353	154.455	234.611	0	234.611
24	0.237959	5.31954	CL w/shell	50	24	95.9852	148.647	221.566	0	221.566
25	0.237959	1.77533	CL w/shell	50	24	92.2248	142.824	208.486	0	208.486

Global Minimum Query (janbu simplified) - Safety Factor: 1.54638

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

					[degrees]			[psf]		[psf]
1	0.211609	0.957434	CL w/shell	50	24	29.3069	45.3196	-10.5123	0	-10.5123
2	0.211609	2.86682	CL w/shell	50	24	31.5543	48.795	-2.70656	0	-2.70656
3	0.211609	4.76521	CL w/shell	50	24	33.7864	52.2466	5.04585	0	5.04585
4	0.211609	6.6526	CL w/shell	50	24	36.0031	55.6744	12.7449	0	12.7449
5	0.211609	8.52895	CL w/shell	50	24	38.2044	59.0785	20.3905	0	20.3905
6	0.211609	10.3942	CL w/shell	50	24	40.3903	62.4587	27.9826	0	27.9826
7	0.211609	12.2484	CL w/shell	50	24	42.5608	65.8151	35.5212	0	35.5212
8	0.211609	14.0915	CL w/shell	50	24	44.7158	69.1476	43.0062	0	43.0062
9	0.211609	15.9234	CL w/shell	50	24	46.8554	72.4562	50.4372	0	50.4372
10	0.211609	17.7441	CL w/shell	50	24	48.9795	75.7409	57.8147	0	57.8147
11	0.211609	19.5537	CL w/shell	50	24	51.0881	79.0016	65.1388	0	65.1388
12	0.211609	21.3519	CL w/shell	50	24	53.1812	82.2383	72.4086	0	72.4086
13	0.211609	23.139	CL w/shell	50	24	55.2587	85.451	79.6241	0	79.6241
14	0.211609	24.9147	CL w/shell	50	24	57.3207	88.6396	86.7859	0	86.7859
15	0.211609	26.6791	CL w/shell	50	24	59.3672	91.8042	93.8939	0	93.8939
16	0.211609	27.57	CL w/shell	50	24	98.349	152.085	229.287	0	229.287
17	0.211609	25.0317	CL w/shell	50	24	119.564	184.891	302.969	0	302.969
18	0.211609	22.1298	CL w/shell	50	24	116.09	179.52	290.907	0	290.907
19	0.211609	19.2164	CL w/shell	50	24	112.608	174.134	278.81	0	278.81
20	0.211609	16.2916	CL w/shell	50	24	109.115	168.733	266.678	0	266.678
21	0.211609	13.3553	CL w/shell	50	24	105.612	163.316	254.511	0	254.511
22	0.211609	10.4074	CL w/shell	50	24	102.099	157.884	242.311	0	242.311
23	0.211609	7.448	CL w/shell	50	24	98.576	152.436	230.075	0	230.075
24	0.211609	4.47695	CL w/shell	50	24	95.0432	146.973	217.805	0	217.805
25	0.211609	1.49426	CL w/shell	50	24	91.5005	141.495	205.5	0	205.5

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.54865

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	408.549	45.2973	0	0	0
2	408.787	45.413	8.11378	0	0
3	409.025	45.5291	15.7771	0	0
4	409.263	45.6456	22.9842	0	0
5	409.5	45.7625	29.7296	0	0
6	409.738	45.8799	36.0078	0	0
7	409.976	45.9977	41.8133	0	0
8	410.214	46.116	47.1407	0	0
9	410.452	46.2347	51.9845	0	0
10	410.69	46.3538	56.3395	0	0
11	410.928	46.4733	60.2004	0	0
12	411.166	46.5933	63.5618	0	0
13	411.404	46.7138	66.4187	0	0
14	411.642	46.8347	68.7658	0	0
15	411.88	46.956	70.5982	0	0
16	412.118	47.0777	66.5265	0	0
17	412.356	47.1999	57.2339	0	0
18	412.594	47.3226	48.4903	0	0
19	412.832	47.4457	40.3087	0	0
20	413.07	47.5692	32.702	0	0
21	413.308	47.6932	25.6835	0	0
22	413.546	47.8176	19.2664	0	0
23	413.784	47.9425	13.4639	0	0
24	414.022	48.0678	8.28962	0	0
25	414.26	48.1936	3.7569	0	0
26	414.498	48.3199	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.54638

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	408.743	45.4667	0	0	0
2	408.955	45.5754	7.33745	0	0
3	409.167	45.6845	14.3027	0	0
4	409.378	45.7941	20.8916	0	0
5	409.59	45.9041	27.1001	0	0
6	409.801	46.0145	32.9241	0	0
7	410.013	46.1254	38.3595	0	0
8	410.225	46.2367	43.4025	0	0

9	410.436	46.3484	48.0491	0	0
10	410.648	46.4606	52.2954	0	0
11	410.859	46.5732	56.1376	0	0
12	411.071	46.6863	59.5719	0	0
13	411.283	46.7998	62.5947	0	0
14	411.494	46.9137	65.2023	0	0
15	411.706	47.0281	67.3909	0	0
16	411.917	47.1429	69.1572	0	0
17	412.129	47.2582	63.7689	0	0
18	412.341	47.374	54.3982	0	0
19	412.552	47.4902	45.5585	0	0
20	412.764	47.6068	37.2622	0	0
21	412.976	47.7239	29.5219	0	0
22	413.187	47.8414	22.3502	0	0
23	413.399	47.9594	15.7598	0	0
24	413.61	48.0779	9.7636	0	0
25	413.822	48.1968	4.37439	0	0
26	414.034	48.3162	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_LT_B22B24_RtSlope
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd. _Long Term Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered),	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

			v/st to h				
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	320	320	50	75	200	200	50
Friction Angle [deg]	28.5	28.5	17	26	20	22	24
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	None
Hu Value			1	1	1	1	
Ru Value	0	0					0

Global Minimums

Method: bishop simplified

FS: 1.053470
Center: 377.658, 75.170
Radius: 54.334
Left Slip Surface Endpoint: 362.441, 23.010
Right Slip Surface Endpoint: 424.942, 48.403
Resisting Moment=1.64436e+006 lb-ft
Driving Moment=1.5609e+006 lb-ft
Total Slice Area=552.3 ft2

Method: janbu simplified

FS: 0.983871
Center: 383.688, 62.481
Radius: 41.575
Left Slip Surface Endpoint: 369.359, 23.454
Right Slip Surface Endpoint: 422.801, 48.386
Resisting Horizontal Force=23812.1 lb
Driving Horizontal Force=24202.4 lb
Total Slice Area=558.712 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.05347

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.46779	115.309	CL3, fm to st	75	26	93.5889	98.5931	71.6984	23.3254	48.373
2	2.46779	327.093	CL3, fm to st	75	26	113.325	119.384	157.167	66.1663	91.001

3	2.46779	525.467	CL3, fm to st	75	26	133.218	140.341	235.47	101.502	133.968
4	2.46779	981.179	CL3, fm to st	75	26	173.179	182.439	418.761	198.479	220.282
5	2.46779	1489.05	CL3, fm to st	75	26	218.799	230.498	620.035	301.215	318.82
6	2.46779	1962.01	CL3, fm to st	75	26	259.171	273.029	802.909	396.887	406.022
7	2.46779	2400.29	CL3, fm to st	75	26	294.639	310.393	968.172	485.546	482.626
8	2.46779	2735.43	CL3, fm to st	75	26	319.107	336.17	1089.05	553.575	535.477
9	2.46779	2930.39	CL3, fm to st	75	26	330.19	347.845	1152.19	592.777	559.413
10	2.46779	3088.97	CL3, fm to st	75	26	337.439	355.482	1199.93	624.855	575.074
11	2.46779	3211.7	CL3, fm to st	75	26	341.174	359.417	1232.82	649.682	583.143
12	2.46779	3301.07	CL3, fm to st	75	26	348.775	367.424	1250.41	650.855	599.556
13	2.46779	3359.24	CL3, fm to st	75	26	368.372	388.069	1250.38	608.491	641.887
14	2.46779	3378.16	CL3, fm to st	75	26	383.68	404.195	1233.1	558.149	674.951
15	2.46779	3564.56	CL3, fm to st	75	26	427.59	450.453	1269.24	499.445	769.791
16	2.46779	3917.09	CL3, fm to st	75	26	497.983	524.61	1353.73	431.896	921.836
17	2.46779	4185.39	CL3, fm to st	75	26	555.194	584.88	1400.31	354.902	1045.41
18	2.46779	4389.91	CL3, fm to st	75	26	602.89	635.127	1416.14	267.708	1148.43
19	2.46779	4502.19	CL3, fm to st	75	26	637.43	671.513	1392.39	169.361	1223.03
20	2.46779	4528.3	CL3, fm to st	75	26	660.391	695.702	1331.26	58.6326	1272.63
21	3.15869	5345.55	CH2, st to h	200	20	656.823	691.943	1351.6	0	1351.6
22	3.15869	4201.12	CH2, st to h	200	20	542.959	571.991	1022.04	0	1022.04
23	2.36443	2282.87	CL1, st	320	28.5	575.408	606.175	527.067	0	527.067
24	2.36443	1423.53	CL1, st	320	28.5	433.414	456.589	251.565	0	251.565
25	2.09863	427.018	CL w/shell	50	24	141.705	149.282	222.991	0	222.991

Global Minimum Query (janbu simplified) - Safety Factor: 0.983871

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.17716	267.904	CL3, fm to st	75	26	128.24	126.172	166.346	61.4276	104.918
2	2.17716	785.955	CL3, fm to st	75	26	192.295	189.193	414.342	180.211	234.131

3	2.17716	1269.27	CL3, fm to st	75	26	247.992	243.992	637.517	291.031	346.486
4	2.17716	1719.24	CL3, fm to st	75	26	296.417	291.636	838.37	394.203	444.167
5	2.17716	2136	CL3, fm to st	75	26	338.171	332.717	1018.36	489.958	528.398
6	2.17716	2439.41	CL3, fm to st	75	26	364.701	358.819	1141.25	559.33	581.918
7	2.17716	2657.9	CL3, fm to st	75	26	380.12	373.989	1222.45	609.428	613.02
8	2.17716	2845.31	CL3, fm to st	75	26	391.297	384.986	1287.97	652.399	635.568
9	2.17716	3001.53	CL3, fm to st	75	26	398.457	392.03	1338.22	688.219	650.005
10	2.17716	3127.17	CL3, fm to st	75	26	401.972	395.489	1373.9	716.802	657.099
11	2.17716	3226.61	CL3, fm to st	75	26	423.512	416.681	1392.82	692.271	700.547
12	2.17716	3293.91	CL3, fm to st	75	26	440.602	433.496	1394.94	659.912	735.027
13	2.17716	3341.86	CL3, fm to st	75	26	455.947	448.593	1385.63	619.648	765.98
14	2.17716	3586.76	CL3, fm to st	75	26	510.898	502.658	1447.91	571.082	876.827
15	2.17716	3869.67	CL3, fm to st	75	26	572.684	563.447	1515.16	513.698	1001.46
16	2.17716	4080.91	CL3, fm to st	75	26	620.628	610.618	1545.01	446.834	1098.18
17	2.17716	4239.04	CL3, fm to st	75	26	658.73	648.105	1544.66	369.624	1175.04
18	2.17716	4328.13	CL3, fm to st	75	26	684.695	673.652	1508.35	280.936	1227.42
19	2.17716	4330.01	CL3, fm to st	75	26	696.16	684.932	1429.8	179.251	1250.55
20	2.17716	4238.69	CL3, fm to st	75	26	728.259	716.513	1377.77	62.47	1315.3
21	2.5134	4264.09	CH2, st to h	200	20	659.026	648.397	1231.96	0	1231.96
22	2.5134	3350.21	CH2, st to h	200	20	530.919	522.356	885.666	0	885.666
23	1.73919	1686.14	CL1, st	320	28.5	532.007	523.426	374.665	0	374.665
24	1.73919	1053.01	CL1, st	320	28.5	385.919	379.694	109.943	0	109.943
25	1.3938	282.648	CL w/shell	50	24	121.439	119.481	156.056	0	156.056

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.05347

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	362.441	23.0103	0	0	0

2	364.909	22.3529	278.467	0	0
3	367.377	21.8176	642.715	0	0
4	369.844	21.4007	1070.16	0	0
5	372.312	21.0996	1624.32	0	0
6	374.78	20.9122	2281.31	0	0
7	377.248	20.8375	2981.93	0	0
8	379.716	20.8749	3673.98	0	0
9	382.183	21.0247	4299.6	0	0
10	384.651	21.2878	4812.59	0	0
11	387.119	21.6659	5192.95	0	0
12	389.587	22.1615	5425.31	0	0
13	392.055	22.7778	5516.71	0	0
14	394.522	23.5193	5500.13	0	0
15	396.99	24.3913	5373.17	0	0
16	399.458	25.4008	5148.76	0	0
17	401.926	26.5564	4815.39	0	0
18	404.394	27.8686	4350.15	0	0
19	406.861	29.351	3741.04	0	0
20	409.329	31.0208	2991.68	0	0
21	411.797	32.9	2122.24	0	0
22	414.956	35.6591	476.926	0	0
23	418.114	38.9	-1111.3	0	0
24	420.479	41.7243	-1232.52	0	0
25	422.843	44.995	-1024.18	0	0
26	424.942	48.4029	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.983871

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	369.359	23.4537	0	0	0
2	371.536	22.7219	402.152	0	0
3	373.713	22.1206	1071.78	0	0
4	375.89	21.6441	1917.88	0	0
5	378.067	21.2879	2864.65	0	0
6	380.244	21.049	3847.36	0	0
7	382.422	20.9254	4785.88	0	0
8	384.599	20.9161	5628.49	0	0
9	386.776	21.0209	6349.1	0	0
10	388.953	21.2408	6926.14	0	0
11	391.13	21.5776	7342.41	0	0
12	393.307	22.0342	7632.53	0	0
13	395.485	22.6148	7786.17	0	0
14	397.662	23.3247	7799.39	0	0
15	399.839	24.1714	7690.72	0	0
16	402.016	25.1639	7439.07	0	0
17	404.193	26.3145	7018.59	0	0

18	406.37	27.6386	6413.68	0	0
19	408.547	29.157	5620.55	0	0
20	410.725	30.8978	4653.94	0	0
21	412.902	32.9	3489.57	0	0
22	415.415	35.6134	1815.37	0	0
23	417.929	38.9	249.789	0	0
24	419.668	41.6499	152.277	0	0
25	421.407	44.995	462.076	0	0
26	422.801	48.3859	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_LT_B22B24_4H1V_RtoL
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd_Long Term Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered),	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

	v/st to h						
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	320	320	50	75	200	200	50
Friction Angle [deg]	28.5	28.5	17	26	20	22	24
Water Surface	None	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	None
Hu Value				1	1	1	
Ru Value	0	0	0				0

Global Minimums

Method: bishop simplified

FS: 1.718450
Center: 387.586, 86.519
Radius: 65.502
Left Slip Surface Endpoint: 369.854, 23.464
Right Slip Surface Endpoint: 432.906, 39.226
Resisting Moment=1.2001e+006 lb-ft
Driving Moment=698359 lb-ft
Total Slice Area=378.364 ft2

Method: janbu simplified

FS: 1.567300
Center: 405.677, 92.864
Radius: 85.417
Left Slip Surface Endpoint: 356.813, 22.805
Right Slip Surface Endpoint: 478.970, 49.000
Resisting Horizontal Force=84730.4 lb
Driving Horizontal Force=54061.5 lb
Total Slice Area=2298 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.71845

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.62974	219.984	CL3, fm to st	75	26	59.9531	103.026	99.2219	41.7593	57.4626
2	2.62974	641.107	CL3, fm to st	75	26	83.4087	143.334	261.805	121.701	140.104
3	2.62974	1025.04	CL3, fm to st	75	26	104.174	179.018	407.848	194.581	213.267

4	2.62974	1372.65	CL3, fm to st	75	26	122.412	210.359	538.094	260.568	277.526
5	2.62974	1684.61	CL3, fm to st	75	26	138.256	237.586	653.141	319.788	333.353
6	2.62974	1961.41	CL3, fm to st	75	26	151.818	260.891	753.465	372.332	381.133
7	2.62974	2203.34	CL3, fm to st	75	26	163.188	280.43	839.45	418.257	421.193
8	2.62974	2410.52	CL3, fm to st	75	26	172.44	296.329	911.38	457.585	453.795
9	2.62974	2582.91	CL3, fm to st	75	26	179.634	308.692	969.45	490.31	479.14
10	2.62974	2720.3	CL3, fm to st	75	26	184.817	317.598	1013.79	516.391	497.401
11	2.62974	2822.3	CL3, fm to st	75	26	188.022	323.107	1044.45	535.753	508.695
12	2.62974	2888.33	CL3, fm to st	75	26	189.275	325.259	1061.39	548.288	513.104
13	2.62974	2917.62	CL3, fm to st	75	26	188.587	324.078	1064.53	553.848	510.684
14	2.62974	2909.18	CL3, fm to st	75	26	185.964	319.569	1053.69	552.245	501.442
15	2.62974	2863.56	CL3, fm to st	75	26	183.208	314.834	1028.69	536.955	491.733
16	2.62974	2783.73	CL3, fm to st	75	26	188.445	323.834	987.564	477.381	510.183
17	2.62974	2662.05	CL3, fm to st	75	26	191.448	328.993	930.525	409.761	520.764
18	2.62974	2495.71	CL3, fm to st	75	26	192.109	330.13	856.758	333.663	523.095
19	2.62974	2277.04	CL3, fm to st	75	26	189.902	326.337	763.88	248.563	515.317
20	2.62974	1998.57	CL3, fm to st	75	26	184.382	316.851	649.685	153.816	495.869
21	2.62974	1664.93	CL3, fm to st	75	26	176.277	302.923	515.946	48.6322	467.313
22	1.93624	983.732	CH2, st to h	200	20	194.082	333.52	366.845	0	366.845
23	1.93624	752.925	CH2, st to h	200	20	170.383	292.795	254.952	0	254.952
24	3.61129	643.659	CH1 (weathered), v/st to h	50	17	52.5758	90.3489	131.975	0	131.975
25	0.343154	4.95527	CL1, st	320	28.5	146.589	251.906	-125.413	0	-125.413

Global Minimum Query (janbu simplified) - Safety Factor: 1.5673

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.22273	219.521	CL3, fm to st	75	26	80.0609	125.48	152.8	49.302	103.498
2	5.08041	2012.91	CH2, st to h	200	20	201.411	315.671	517.839	200.035	317.804
3	5.08041	3891.38	CH2, st to h	200	20	244.408	383.06	891.668	388.716	502.952
4	5.08041	5871.95	CH2, st to h	200	20	288.811	452.653	1281.04	586.884	694.159
5	5.08041	7927.19	CH2, st to h	200	20	333.979	523.445	1680.41	791.749	888.658
6	5.08041	9756.85	CH2, st to h	200	20	372.541	583.884	2028.61	973.904	1054.71
7	5.08041	11374.4	CH2, st to h	200	20	405.166	635.016	2329.9	1134.71	1195.19
8	5.08041	12789.8	CH2, st to h	200	20	432.345	677.615	2587.39	1275.15	1312.24
9	5.08041	14010	CH2, st to h	200	20	454.448	712.257	2803.37	1395.95	1407.42
10	5.08041	15039.6	CH2, st to h	200	20	471.744	739.364	2979.46	1497.56	1481.9
11	5.08041	15884.2	CH2, st to h	200	20	484.568	759.463	3117.34	1580.22	1537.12
12	5.08041	16565	CH2, st to h	200	20	511.757	802.077	3220.24	1566.04	1654.2
13	5.08041	17055.7	CH2, st to h	200	20	535.085	838.638	3282.52	1527.88	1754.64
14	5.08041	17313.8	CH2, st to h	200	20	551.752	864.761	3296.68	1470.27	1826.41
15	5.08041	17365.1	CH2, st to h	200	20	563.163	882.645	3268.14	1392.59	1875.55
16	5.08041	17191.6	CH2, st to h	200	20	568.835	891.535	3193.93	1293.94	1899.99
17	5.08041	16752.6	CH2, st to h	200	20	567.417	889.313	3067	1173.13	1893.87

18	5.08041	16088.7	CH2, st to h	200	20	561.076	879.375	2895.08	1028.51	1866.57
19	5.08041	15202.3	CH2, st to h	200	20	550.385	862.618	2678.43	857.892	1820.54
20	5.14618	14174.7	CL3, fm to st	75	26	580.059	909.127	2367.02	656.815	1710.21
21	5.14618	12571.6	CL3, fm to st	75	26	544.698	853.705	2017.28	420.691	1596.59
22	5.14618	10555.5	CL3, fm to st	75	26	498.769	781.721	1593.51	144.515	1448.99
23	5.96605	9074.36	CH2, st to h	200	20	382.622	599.684	1098.12	0	1098.12
24	4.532	3835.24	CL1, st	320	28.5	396.776	621.867	555.969	0	555.969
25	2.55069	612.93	CL w/shell	50	24	118.349	185.489	304.313	0	304.313

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.71845

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	369.854	23.4636	0	0	0
2	372.484	22.7826	225.678	0	0
3	375.114	22.2162	593.915	0	0
4	377.744	21.7615	1054.09	0	0
5	380.373	21.4161	1562.77	0	0
6	383.003	21.1783	2082.7	0	0
7	385.633	21.0469	2582.09	0	0
8	388.263	21.0213	3033.98	0	0
9	390.892	21.1012	3415.84	0	0
10	393.522	21.2873	3709.24	0	0
11	396.152	21.5802	3899.65	0	0
12	398.782	21.9815	3976.32	0	0
13	401.411	22.4933	3932.28	0	0
14	404.041	23.1182	3764.42	0	0
15	406.671	23.8596	3473.67	0	0
16	409.3	24.7216	3070.04	0	0
17	411.93	25.7095	2591.43	0	0
18	414.56	26.8294	2054.2	0	0
19	417.19	28.089	1481.67	0	0
20	419.819	29.4975	906.569	0	0
21	422.449	31.0662	373.635	0	0
22	425.079	32.8092	-60.7953	0	0
23	427.015	34.2141	-199.309	0	0
24	428.951	35.7315	-255.342	0	0
25	432.563	38.9	-483.1	0	0
26	432.906	39.2265	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.5673

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	356.813	22.8047	0	0	0
2	359.035	21.3057	407.151	0	0
3	364.116	18.2404	3018.65	0	0
4	369.196	15.6295	6589.42	0	0
5	374.277	13.4283	10877.8	0	0
6	379.357	11.6035	15642.4	0	0
7	384.437	10.1302	20525.5	0	0
8	389.518	8.98983	25242.6	0	0
9	394.598	8.16896	29564.9	0	0
10	399.679	7.65835	33307.1	0	0
11	404.759	7.45243	36319.3	0	0
12	409.839	7.54901	38482.2	0	0
13	414.92	7.94911	39795.9	0	0
14	420	8.65707	40192.8	0	0
15	425.081	9.68074	39623.6	0	0
16	430.161	11.032	38071.2	0	0
17	435.242	12.7273	35548.8	0	0
18	440.322	14.7892	32110.2	0	0
19	445.402	17.2476	27845.8	0	0
20	450.483	20.1427	22890	0	0
21	455.629	23.5766	17749.5	0	0
22	460.775	27.5943	12450.3	0	0
23	465.921	32.3119	7501.69	0	0
24	471.887	38.9	2551.9	0	0
25	476.419	44.995	963	0	0
26	478.97	49	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_RD_B22B24_RtoL
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered), v/st to h	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

			v/st to h				
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	320	320	50	75	200	200	50
Friction Angle [deg]	28.5	28.5	17	26	20	22	24
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 0.664780
Center: 395.748, 49.791
Radius: 16.415
Left Slip Surface Endpoint: 392.450, 33.711
Right Slip Surface Endpoint: 412.096, 48.301
Resisting Moment=52895.4 lb-ft
Driving Moment=79568.3 lb-ft
Total Slice Area=74.902 ft2

Method: janbu simplified

FS: 0.670324
Center: 395.748, 49.791
Radius: 16.415
Left Slip Surface Endpoint: 392.450, 33.711
Right Slip Surface Endpoint: 412.096, 48.301
Resisting Horizontal Force=2315.5 lb
Driving Horizontal Force=3454.3 lb
Total Slice Area=74.902 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.66478

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.779017	20.4474	CH1 (weathered), v/st to h	50	17	88.8228	59.0476	42.1925	12.5989	29.5936
2	0.779017	59.4009	CH1 (weathered), v/st to h	50	17	99.4127	66.0876	89.2206	36.6005	52.6201
			CH1 (weathered),							

			v/st to h							
4	0.779017	125.827	CH1 (weathered), v/st to h	50	17	115.689	76.908	165.541	77.5295	88.0119
5	0.779017	153.39	CH1 (weathered), v/st to h	50	17	121.598	80.8361	195.373	94.5127	100.86
6	0.779017	177.732	CH1 (weathered), v/st to h	50	17	126.436	84.0523	220.565	109.185	111.38
7	0.779017	224.889	CH1 (weathered), v/st to h	50	17	137.436	91.3649	273.866	138.568	135.298
8	0.779017	283.069	CH1 (weathered), v/st to h	50	17	151.234	100.537	339.716	174.416	165.3
9	0.779017	337.359	CH1 (weathered), v/st to h	50	17	163.301	108.559	399.406	207.868	191.538
10	0.779017	387.656	CH1 (weathered), v/st to h	50	17	173.669	115.451	452.94	238.858	214.082
11	0.779017	433.82	CH1 (weathered), v/st to h	50	17	182.352	121.224	500.265	267.303	232.962
12	0.779017	474.093	CH1 (weathered), v/st to h	50	17	188.55	125.344	539.53	293.091	246.439
13	0.779017	506.263	CH1 (weathered), v/st to h	50	17	191.316	127.183	568.536	316.082	252.454
14	0.779017	533.471	CH1 (weathered), v/st to h	50	17	192.39	127.897	590.889	336.1	254.789
15	0.779017	555.491	CH1 (weathered), v/st to h	50	17	191.784	127.494	606.394	352.921	253.473
16	0.779017	571.864	CH1 (weathered), v/st to h	50	17	189.419	125.922	614.593	366.262	248.331
17	0.779017	581.995	CH1 (weathered), v/st to h	50	17	185.188	123.109	614.887	375.758	239.129
18	0.779017	585.109	CH1 (weathered), v/st to h	50	17	178.942	118.957	606.479	380.93	225.549
19	0.779017	580.16	CH1 (weathered), v/st to h	50	17	170.486	113.336	588.295	381.134	207.161
20	0.779017	565.688	CH1 (weathered), v/st to h	50	17	159.545	106.062	558.842	375.47	183.372
21	0.854317	594.006	CL1, st	320	28.5	377.397	250.886	234.263	361.556	-127.293
22	0.854317	552.073	CL1, st	320	28.5	334.264	222.212	155.929	336.032	-180.103
23	0.854317	482.843	CL1, st	320	28.5	280.6	186.537	48.0863	293.894	-245.808
24	0.854317	364.748	CL1, st	320	28.5	208.85	138.839	-111.645	222.012	-333.657
25	0.648546	112.637	CL w/shell	50	24	35.3327	23.4885	31.1466	90.6925	-59.5459

Global Minimum Query (janbu simplified) - Safety Factor: 0.670324

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.779017	20.4474	CH1 (weathered), v/st to h	50	17	88.0312	59.0095	42.0675	12.5989	29.4686
2	0.779017	59.4009	CH1 (weathered), v/st to h	50	17	98.5453	66.0573	89.1215	36.6005	52.521
			CH1 (weathered),							

			v/st to h							
4	0.779017	125.827	CH1 (weathered), v/st to h	50	17	114.719	76.899	165.512	77.5295	87.9824
5	0.779017	153.39	CH1 (weathered), v/st to h	50	17	120.598	80.8395	195.385	94.5127	100.872
6	0.779017	177.732	CH1 (weathered), v/st to h	50	17	125.415	84.0685	220.618	109.185	111.433
7	0.779017	224.889	CH1 (weathered), v/st to h	50	17	136.346	91.3959	273.968	138.568	135.4
8	0.779017	283.069	CH1 (weathered), v/st to h	50	17	150.056	100.586	339.875	174.416	165.459
9	0.779017	337.359	CH1 (weathered), v/st to h	50	17	162.051	108.627	399.627	207.868	191.759
10	0.779017	387.656	CH1 (weathered), v/st to h	50	17	172.363	115.539	453.228	238.858	214.37
11	0.779017	433.82	CH1 (weathered), v/st to h	50	17	181.006	121.333	500.622	267.303	233.319
12	0.779017	474.093	CH1 (weathered), v/st to h	50	17	187.184	125.474	539.955	293.091	246.864
13	0.779017	506.263	CH1 (weathered), v/st to h	50	17	189.957	127.333	569.026	316.082	252.944
14	0.779017	533.471	CH1 (weathered), v/st to h	50	17	191.05	128.066	591.441	336.1	255.341
15	0.779017	555.491	CH1 (weathered), v/st to h	50	17	190.477	127.681	607.005	352.921	254.084
16	0.779017	571.864	CH1 (weathered), v/st to h	50	17	188.157	126.126	615.26	366.262	248.998
17	0.779017	581.995	CH1 (weathered), v/st to h	50	17	183.983	123.328	615.604	375.758	239.846
18	0.779017	585.109	CH1 (weathered), v/st to h	50	17	177.809	119.19	607.239	380.93	226.309
19	0.779017	580.16	CH1 (weathered), v/st to h	50	17	169.437	113.578	589.088	381.134	207.954
20	0.779017	565.688	CH1 (weathered), v/st to h	50	17	158.597	106.311	559.655	375.47	184.185
21	0.854317	594.006	CL1, st	320	28.5	375.624	251.79	235.929	361.556	-125.627
22	0.854317	552.073	CL1, st	320	28.5	332.804	223.087	157.54	336.032	-178.492
23	0.854317	482.843	CL1, st	320	28.5	279.487	187.347	49.5774	293.894	-244.317
24	0.854317	364.748	CL1, st	320	28.5	208.137	139.519	-110.392	222.012	-332.404
25	0.648546	112.637	CL w/shell	50	24	35.2364	23.6198	31.4417	90.6925	-59.2508

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.66478

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	392.45	33.7109	0	0	0
2	393.229	33.5706	74.8793	0	0

3	394.008	33.4686	161.158	0	0
4	394.787	33.4043	253.641	0	0
5	395.566	33.3771	347.956	0	0
6	396.345	33.3869	440.441	0	0
7	397.124	33.4338	528.26	0	0
8	397.903	33.5181	611.881	0	0
9	398.682	33.6403	687.766	0	0
10	399.461	33.8014	750.21	0	0
11	400.24	34.0025	793.949	0	0
12	401.019	34.2452	814.109	0	0
13	401.798	34.5315	806.046	0	0
14	402.577	34.8638	765.634	0	0
15	403.356	35.2454	689.538	0	0
16	404.135	35.6802	574.782	0	0
17	404.914	36.1733	418.782	0	0
18	405.693	36.7313	219.431	0	0
19	406.472	37.363	-24.7538	0	0
20	407.251	38.0803	-314.363	0	0
21	408.03	38.9	-648.607	0	0
22	408.884	39.9472	-572.614	0	0
23	409.739	41.2046	-484.079	0	0
24	410.593	42.7843	-321.137	0	0
25	411.447	44.995	103.491	0	0
26	412.096	48.3008	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.670324

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	392.45	33.7109	0	0	0
2	393.229	33.5706	74.3215	0	0
3	394.008	33.4686	160	0	0
4	394.787	33.4043	251.85	0	0
5	395.566	33.3771	345.508	0	0
6	396.345	33.3869	437.318	0	0
7	397.124	33.4338	524.447	0	0
8	397.903	33.5181	607.328	0	0
9	398.682	33.6403	682.406	0	0
10	399.461	33.8014	743.98	0	0
11	400.24	34.0025	786.793	0	0
12	401.019	34.2452	805.975	0	0
13	401.798	34.5315	796.889	0	0
14	402.577	34.8638	755.419	0	0
15	403.356	35.2454	678.234	0	0
16	404.135	35.6802	562.357	0	0
17	404.914	36.1733	405.207	0	0
18	405.693	36.7313	204.676	0	0

19	406.472	37.363	-40.718	0	0
20	407.251	38.0803	-331.567	0	0
21	408.03	38.9	-667.081	0	0
22	408.884	39.9472	-593.993	0	0
23	409.739	41.2046	-508.418	0	0
24	410.593	42.7843	-348.52	0	0
25	411.447	44.995	72.9242	0	0
26	412.096	48.3008	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_RD_B22B24_3H1V_RtoL
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered),	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

			v/st to h				
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	320	320	50	75	200	200	50
Friction Angle [deg]	28.5	28.5	17	26	20	22	24
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 1.120960
Center: 386.454, 106.929
Radius: 86.522
Left Slip Surface Endpoint: 365.015, 23.104
Right Slip Surface Endpoint: 450.300, 48.535
Resisting Moment=2.67707e+006 lb-ft
Driving Moment=2.38819e+006 lb-ft
Total Slice Area=765.085 ft2

Method: janbu simplified

FS: 1.036800
Center: 398.514, 75.205
Radius: 63.881
Left Slip Surface Endpoint: 361.721, 22.984
Right Slip Surface Endpoint: 456.561, 48.535
Resisting Horizontal Force=51706.8 lb
Driving Horizontal Force=49871.6 lb
Total Slice Area=1636.49 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.12096

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.48561	205.307	CL3, fm to st	75	26	88.7883	99.5281	79.6936	29.4035	50.2901
2	3.48561	748.605	CL3, fm to st	75	26	124.329	139.368	238.524	106.55	131.974
			CL3, fm to st							

4	3.48561	2208.73	CL3, fm to st	75	26	215.05	241.062	656.806	316.329	340.477
5	3.48561	2847.15	CL3, fm to st	75	26	252.22	282.729	833.668	407.761	425.907
6	3.48561	3423.91	CL3, fm to st	75	26	284.198	318.575	989.765	490.365	499.4
7	3.48561	3939.37	CL3, fm to st	75	26	311.264	348.915	1125.8	564.187	561.609
8	3.48561	4393.57	CL3, fm to st	75	26	333.652	374.01	1242.3	629.237	613.059
9	3.48561	4786.25	CL3, fm to st	75	26	351.55	394.073	1339.67	685.476	654.195
10	3.48561	5119.93	CL3, fm to st	75	26	365.476	409.684	1419.03	732.824	686.204
11	3.48561	5405.78	CL3, fm to st	75	26	376.934	422.528	1483.69	771.155	712.538
12	3.48561	5629.44	CL3, fm to st	75	26	384.436	430.937	1530.07	800.293	729.777
13	3.48561	5769.84	CL3, fm to st	75	26	385.862	432.536	1553.07	820.008	733.059
14	3.48561	5828.31	CL3, fm to st	75	26	381.734	427.909	1553.58	830.011	723.571
15	3.48561	5813.44	CL3, fm to st	75	26	373.358	418.519	1534.26	829.943	704.318
16	3.48561	5695.31	CL3, fm to st	75	26	357.91	401.203	1488.18	819.364	668.816
17	3.48561	5492.45	CL3, fm to st	75	26	337.872	378.741	1420.5	797.738	622.761
18	3.48561	5217.12	CL3, fm to st	75	26	314.973	353.072	1334.55	764.415	570.132
19	3.48561	4876.08	CL3, fm to st	75	26	290.336	325.455	1232.11	718.598	513.508
20	2.89175	3730.18	CH2, st to h	200	20	316.167	354.411	1089.72	665.48	424.241
21	2.89175	3390.19	CH2, st to h	200	20	295.837	331.622	967.959	606.329	361.63
22	2.89175	2988.85	CH2, st to h	200	20	273.052	306.08	827.779	536.329	291.45
23	3.47784	2974.33	CL1, st	320	28.5	345.406	387.186	568.459	444.717	123.742
24	3.47784	2104.84	CL1, st	320	28.5	340.726	381.941	435.163	321.083	114.08
25	3.42752	727.933	CL w/shell	50	24	130.701	146.511	327.204	110.437	216.767

Global Minimum Query (janbu simplified) - Safety Factor: 1.0368

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.68041	584.807	CL3, fm to st	75	26	158.668	164.507	262.838	79.3214	183.517
2	3.79729	1733.72	CH2, st to h	200	20	339.552	352.048	647.12	229.373	417.747
3	3.79729	3006.16	CH2, st to h	200	20	396.862	411.467	980.605	399.606	580.999
4	3.79729	4376.09	CH2, st to h	200	20	457.09	473.911	1334.66	582.098	752.563

5	3.79729	5615.04	CH2, st to h	200	20	508.112	526.811	1644.85	746.948	897.905
6	3.79729	6731.82	CH2, st to h	200	20	551.163	571.446	1915.88	895.342	1020.54
7	3.79729	7732.95	CH2, st to h	200	20	587.126	608.732	2151.14	1028.16	1122.98
8	3.79729	8623.18	CH2, st to h	200	20	616.648	639.341	2353.12	1146.04	1207.08
9	3.79729	9405.79	CH2, st to h	200	20	640.207	663.767	2523.61	1249.42	1274.19
10	3.79729	10085	CH2, st to h	200	20	658.356	682.583	2664.46	1338.57	1325.89
11	3.79729	10677.2	CH2, st to h	200	20	672.758	697.515	2780.52	1413.61	1366.91
12	3.79729	11167.9	CH2, st to h	200	20	682.204	707.309	2868.3	1474.48	1393.82
13	3.79729	11528.7	CH2, st to h	200	20	684.434	709.621	2921.17	1520.99	1400.18
14	3.79729	11766.3	CH2, st to h	200	20	680.394	705.432	2941.44	1552.78	1388.66
15	3.79729	11879.2	CH2, st to h	200	20	670.339	695.007	2929.31	1569.3	1360.01
16	3.79729	11838.7	CH2, st to h	200	20	652.347	676.353	2878.57	1569.79	1308.78
17	3.79729	11670.5	CH2, st to h	200	20	629.117	652.269	2795.79	1553.2	1242.59
18	3.79729	11391.5	CH2, st to h	200	20	602.529	624.702	2685.01	1518.14	1166.87
19	4.1059	11820.8	CL3, fm to st	75	26	573.559	594.666	2525.01	1459.53	1065.48
20	4.1059	11077.6	CL3, fm to st	75	26	517.976	537.037	2319.91	1372.59	947.322
21	4.1059	10074.3	CL3, fm to st	75	26	452.611	469.267	2062.39	1254.03	808.36
22	4.1059	8705.96	CL3, fm to st	75	26	402.183	416.983	1797.91	1096.73	701.176
23	4.69659	7148.96	CH2, st to h	200	20	371.449	385.118	1297.01	788.402	508.61
24	3.72457	2944.12	CL1, st	320	28.5	343.505	356.146	477.611	411.038	66.5727
25	1.76097	373.994	CL w/shell	50	24	106.936	110.871	247.155	110.437	136.718

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.12096

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	365.015	23.1044	0	0	0
2	368.5	22.2893	374.889	0	0
3	371.986	21.6243	967.501	0	0
4	375.471	21.106	1806.69	0	0
5	378.957	20.7315	2803.31	0	0
6	382.443	20.4991	3877.45	0	0
7	385.928	20.4077	4960	0	0
8	389.414	20.4568	5991.31	0	0
9	392.9	20.6465	6920.23	0	0
10	396.385	20.978	7703.38	0	0
11	399.871	21.4527	8305.49	0	0
12	403.356	22.0732	8700.71	0	0
13	406.842	22.8425	8865.45	0	0
14	410.328	23.765	8779.76	0	0

15	413.813	24.8457	8433.37	0	0
16	417.299	26.0909	7826.11	0	0
17	420.784	27.5085	6965.88	0	0
18	424.27	29.1078	5873.49	0	0
19	427.756	30.9003	4580.8	0	0
20	431.241	32.9	3130.4	0	0
21	434.133	34.7286	2053.38	0	0
22	437.025	36.7237	978.937	0	0
23	439.916	38.9	-31.8165	0	0
24	443.394	41.7832	-467.757	0	0
25	446.872	44.995	-678.698	0	0
26	450.3	48.5347	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.0368

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	361.721	22.984	0	0	0
2	365.401	20.5762	1217.6	0	0
3	369.199	18.4479	3885.87	0	0
4	372.996	16.6423	7165.37	0	0
5	376.793	15.1303	10921.3	0	0
6	380.59	13.8902	14893.1	0	0
7	384.388	12.9057	18875	0	0
8	388.185	12.1648	22701.1	0	0
9	391.982	11.659	26235.9	0	0
10	395.78	11.3828	29367.2	0	0
11	399.577	11.3331	32002.8	0	0
12	403.374	11.5094	34070.5	0	0
13	407.171	11.9136	35505	0	0
14	410.969	12.5501	36247.9	0	0
15	414.766	13.4262	36258	0	0
16	418.563	14.5521	35508.6	0	0
17	422.361	15.9421	33987.7	0	0
18	426.158	17.6154	31701.6	0	0
19	429.955	19.5974	28670.8	0	0
20	434.061	22.1281	24638.8	0	0
21	438.167	25.1212	19824.7	0	0
22	442.273	28.6657	14375.3	0	0
23	446.379	32.9	8415.84	0	0
24	451.075	38.9	2380.57	0	0
25	454.8	44.995	750.588	0	0
26	456.561	48.5347	0	0	0

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: G13-120_Bayou at Link Rd_RD_B22B24_4H1V_RtoL
Slide Modeler Version: 6.022
Project Title: SLIDE - An Interactive Slope Stability Program
Analysis: Little White Oak Bayou at Link Rd. _Rapid Drawdown Condition (B-22 and B-24)
Author: PST
Company: ATL
Date Created: 5/13/2013

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1

Loading

2 Distributed Loads present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Distributed Load 2

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

Material Properties

Property	CL1, st	CL2, v/st	CH1 (weathered),	CL3, fm to st	CH2, st to h	CH3, v/st to h	CL w/shell

			v/st to h				
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	125	130	125	122	122	120
Cohesion [psf]	320	320	50	75	200	200	50
Friction Angle [deg]	28.5	28.5	17	26	20	22	24
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS: 1.404150
Center: 406.401, 120.745
Radius: 107.559
Left Slip Surface Endpoint: 361.563, 22.978
Right Slip Surface Endpoint: 486.535, 49.000
Resisting Moment=7.58981e+006 lb-ft
Driving Moment=5.40526e+006 lb-ft
Total Slice Area=1927.75 ft2

Method: janbu simplified

FS: 1.258990
Center: 412.431, 89.022
Radius: 82.519
Left Slip Surface Endpoint: 362.892, 23.027
Right Slip Surface Endpoint: 484.595, 49.000
Resisting Horizontal Force=77338.4 lb
Driving Horizontal Force=61428.8 lb
Total Slice Area=2535.31 ft2

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.40415

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.0461	481.479	CL3, fm to st	75	26	87.2917	122.571	156.938	59.4039	97.5345
2	4.94	1831.73	CH2, st to h	200	20	212.049	297.749	451.792	183.231	268.561
3	4.94	3495.84	CH2, st to h	200	20	254.899	357.916	791.023	357.153	433.87

4	4.94	5153.84	CH2, st to h	200	20	297.487	417.716	1124.99	526.827	598.168
5	4.94	6659.1	CH2, st to h	200	20	334.878	470.219	1423.11	680.686	742.421
6	4.94	8016.95	CH2, st to h	200	20	367.447	515.951	1687.35	819.283	868.067
7	4.94	9231.49	CH2, st to h	200	20	395.492	555.33	1919.3	943.043	976.259
8	4.94	10305.7	CH2, st to h	200	20	419.249	588.689	2120.18	1052.28	1067.9
9	4.94	11241.7	CH2, st to h	200	20	438.91	616.295	2290.96	1147.19	1143.77
10	4.94	12044.3	CH2, st to h	200	20	454.82	638.635	2433.05	1227.91	1205.14
11	4.94	12732.8	CH2, st to h	200	20	468.07	657.241	2550.69	1294.44	1256.25
12	4.94	13282.1	CH2, st to h	200	20	477.448	670.408	2639.16	1346.73	1292.43
13	4.94	13655	CH2, st to h	200	20	481.213	675.695	2691.57	1384.61	1306.96
14	4.94	13879.3	CH2, st to h	200	20	480.972	675.357	2713.86	1407.83	1306.03
15	4.94	13945.9	CH2, st to h	200	20	476.462	669.024	2704.65	1416.02	1288.63
16	4.94	13818.1	CH2, st to h	200	20	466.125	654.51	2657.44	1408.69	1248.75
17	4.94	13539.7	CH2, st to h	200	20	452.385	635.217	2580.99	1385.24	1195.75
18	5.73671	15175.9	CL3, fm to st	75	26	443.047	622.105	2461.77	1340.05	1121.72
19	5.73671	14314.8	CL3, fm to st	75	26	410.331	576.166	2296.34	1268.8	1027.54
20	5.73671	13151.4	CL3, fm to st	75	26	370.586	520.358	2084.36	1171.25	913.112
21	5.73671	11655.4	CL3, fm to st	75	26	323.551	454.314	1822.47	1044.75	777.716
22	4.29607	7558.91	CH2, st to h	200	20	304.997	428.262	1536.84	909.693	627.144
23	4.29607	6117.72	CH2, st to h	200	20	316.718	444.72	1411.07	738.708	672.363
24	6.5725	5562.31	CL1, st	320	28.5	354.388	497.614	767.201	440.076	327.125
25	3.77473	907.068	CL w/shell	50	24	113.287	159.072	369.935	124.956	244.979

Global Minimum Query (janbu simplified) - Safety Factor: 1.25899

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.49618	295.349	CL3, fm to st	75	26	114.493	144.146	200.835	59.0655	141.769
2	5.13029	2333.77	CH2, st to h	200	20	275.889	347.342	631.323	226.503	404.82
3	5.13029	4883.25	CH2, st to h	200	20	349.437	439.938	1141.25	482.022	659.224
4	5.13029	7310.47	CH2, st to h	200	20	416.978	524.971	1614.79	721.941	892.85
5	5.13029	9471.17	CH2, st to h	200	20	473.708	596.394	2024.38	935.289	1089.09
6	5.13029	11387.1	CH2, st to h	200	20	521.182	656.163	2377.53	1124.24	1253.29
7	5.13029	13074.4	CH2, st to h	200	20	560.493	705.655	2679.66	1290.38	1389.28
8	5.13029	14544.6	CH2, st to h	200	20	592.43	745.864	2934.64	1434.89	1499.75
9	5.13029	15806.1	CH2, st to h	200	20	617.574	777.52	3145.32	1558.59	1586.73
10	5.13029	16874	CH2, st to h	200	20	636.903	801.854	3315.59	1662.01	1653.58
11	5.13029	17763.4	CH2, st to h	200	20	651.382	820.084	3449.1	1745.42	1703.68
12	5.13029	18435.5	CH2, st to h	200	20	658.985	829.655	3538.83	1808.87	1729.96
13	5.13029	18870.7	CH2, st to h	200	20	658.923	829.577	3581.91	1852.16	1729.75
14	5.13029	19098	CH2, st to h	200	20	653.119	822.27	3584.52	1874.85	1709.67
15	5.13029	19073	CH2, st to h	200	20	639.595	805.244	3539.1	1876.21	1662.89

16	5.13029	18797.1	CH2, st to h	200	20	618.968	779.274	3446.75	1855.22	1591.53
17	5.13029	18315.2	CH2, st to h	200	20	594.09	747.953	3315.91	1810.42	1505.49
18	5.13029	17594.3	CH2, st to h	200	20	563.927	709.978	3141.02	1739.86	1401.16
19	5.13029	16588.4	CH2, st to h	200	20	527.07	663.576	2914.54	1640.88	1273.66
20	4.85613	14461.9	CL3, fm to st	75	26	491.684	619.025	2629.65	1514.23	1115.42
21	4.85613	12902.1	CL3, fm to st	75	26	426.543	537.014	2304.28	1357.01	947.27
22	4.85613	10955.5	CL3, fm to st	75	26	356.296	448.573	1926.1	1160.17	765.934
23	5.68178	9196.59	CH2, st to h	200	20	341.207	429.576	1468.96	838.211	630.752
24	4.23979	3588.14	CL1, st	320	28.5	331.804	417.737	620.086	440.076	180.01
25	2.37126	569.813	CL w/shell	50	24	105.815	133.22	311.872	124.956	186.916

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.40415

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	361.563	22.9783	0	0	0
2	365.609	21.2221	629.288	0	0
3	370.549	19.3378	2529.6	0	0
4	375.489	17.7244	5066.75	0	0
5	380.429	16.3695	8062.67	0	0
6	385.369	15.263	11293.9	0	0
7	390.309	14.3973	14572.4	0	0
8	395.249	13.7664	17739.8	0	0
9	400.189	13.3662	20662.2	0	0
10	405.129	13.1942	23227.5	0	0
11	410.069	13.2493	25343.5	0	0
12	415.009	13.5317	26938.6	0	0
13	419.949	14.0433	27950.1	0	0
14	424.889	14.7875	28327.6	0	0
15	429.829	15.7692	28042.9	0	0
16	434.769	16.995	27084.3	0	0
17	439.709	18.4739	25460.2	0	0
18	444.649	20.2169	23199.4	0	0
19	450.386	22.5913	19899.4	0	0
20	456.122	25.369	15878.1	0	0
21	461.859	28.5864	11300.7	0	0
22	467.596	32.2916	6406.88	0	0
23	471.892	35.4235	2905.76	0	0
24	476.188	38.9	-637.324	0	0
25	482.76	44.995	-2980.95	0	0
26	486.535	49	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.25899

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	362.892	23.0268	0	0	0
2	365.389	21.2249	647.218	0	0
3	370.519	17.9389	4134.84	0	0
4	375.649	15.1537	9103.25	0	0
5	380.779	12.8143	15016.6	0	0
6	385.91	10.8808	21357.1	0	0
7	391.04	9.3235	27729.1	0	0
8	396.17	8.12074	33822.8	0	0
9	401.301	7.25687	39392.4	0	0
10	406.431	6.72121	44240.4	0	0
11	411.561	6.50738	48211.5	0	0
12	416.692	6.61286	51184.1	0	0
13	421.822	7.03889	53051.7	0	0
14	426.952	7.79051	53734.4	0	0
15	432.082	8.87689	53185.5	0	0
16	437.213	10.3119	51382.9	0	0
17	442.343	12.115	48338.3	0	0
18	447.473	14.3129	44093.2	0	0
19	452.604	16.9416	38724.7	0	0
20	457.734	20.0505	32363.3	0	0
21	462.59	23.4973	25683.3	0	0
22	467.446	27.5179	18486.6	0	0
23	472.302	32.2343	11129.9	0	0
24	477.984	38.9	3273.61	0	0
25	482.224	44.995	898.678	0	0
26	484.595	49	0	0	0

APPENDIX 6

ALLOWABLE COMPRESSION AND UPLIFT CAPACITY CURVES FOR 16-INCH SQUARE PILES SUPPORTING WATER LINE AERIAL CROSSING OVER LITTLE WHITE OAK BAYOU AT ENID STREET

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #1 (Boring B-22)

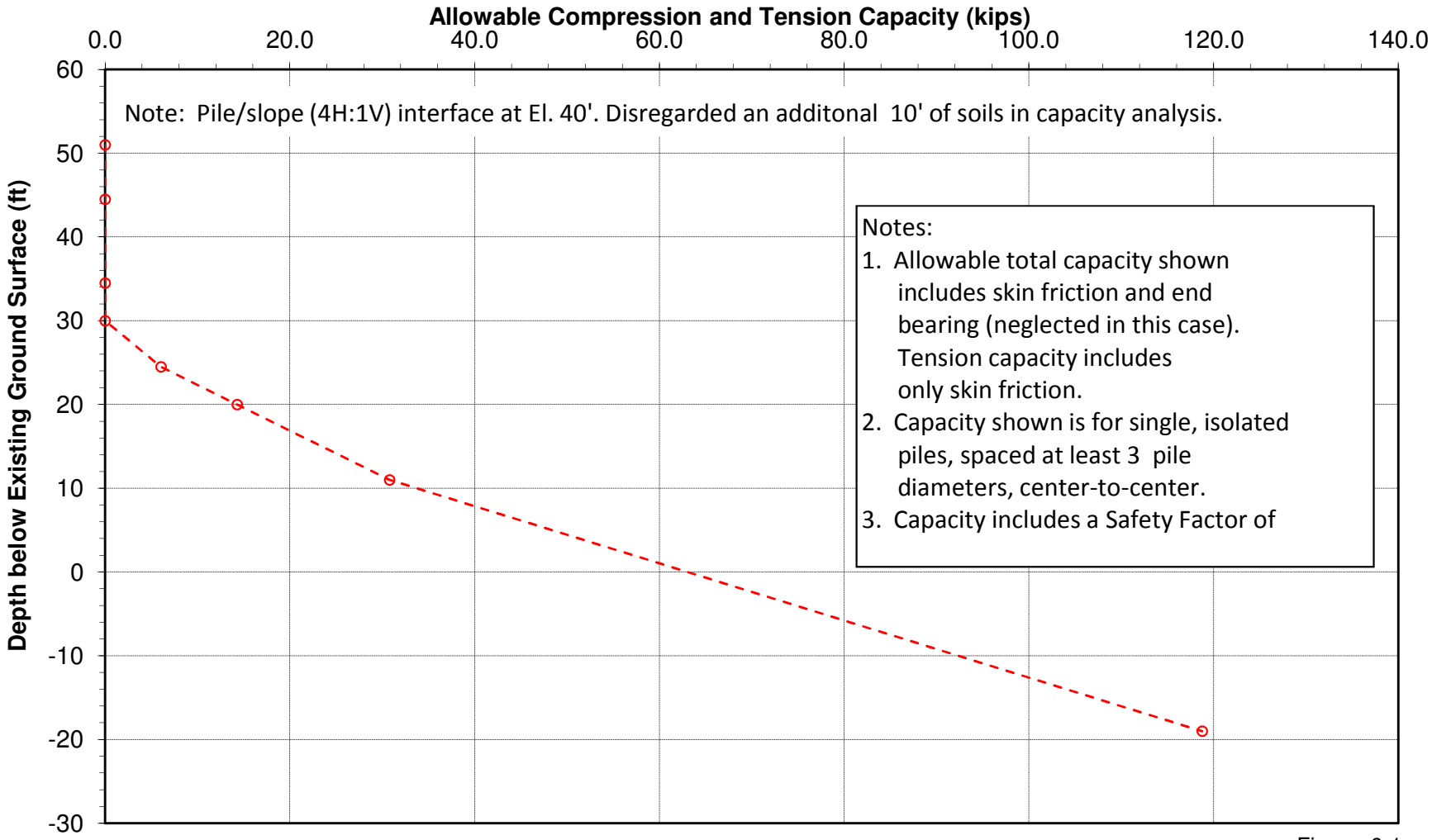


Figure 6-1

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #2 (Boring B-22)

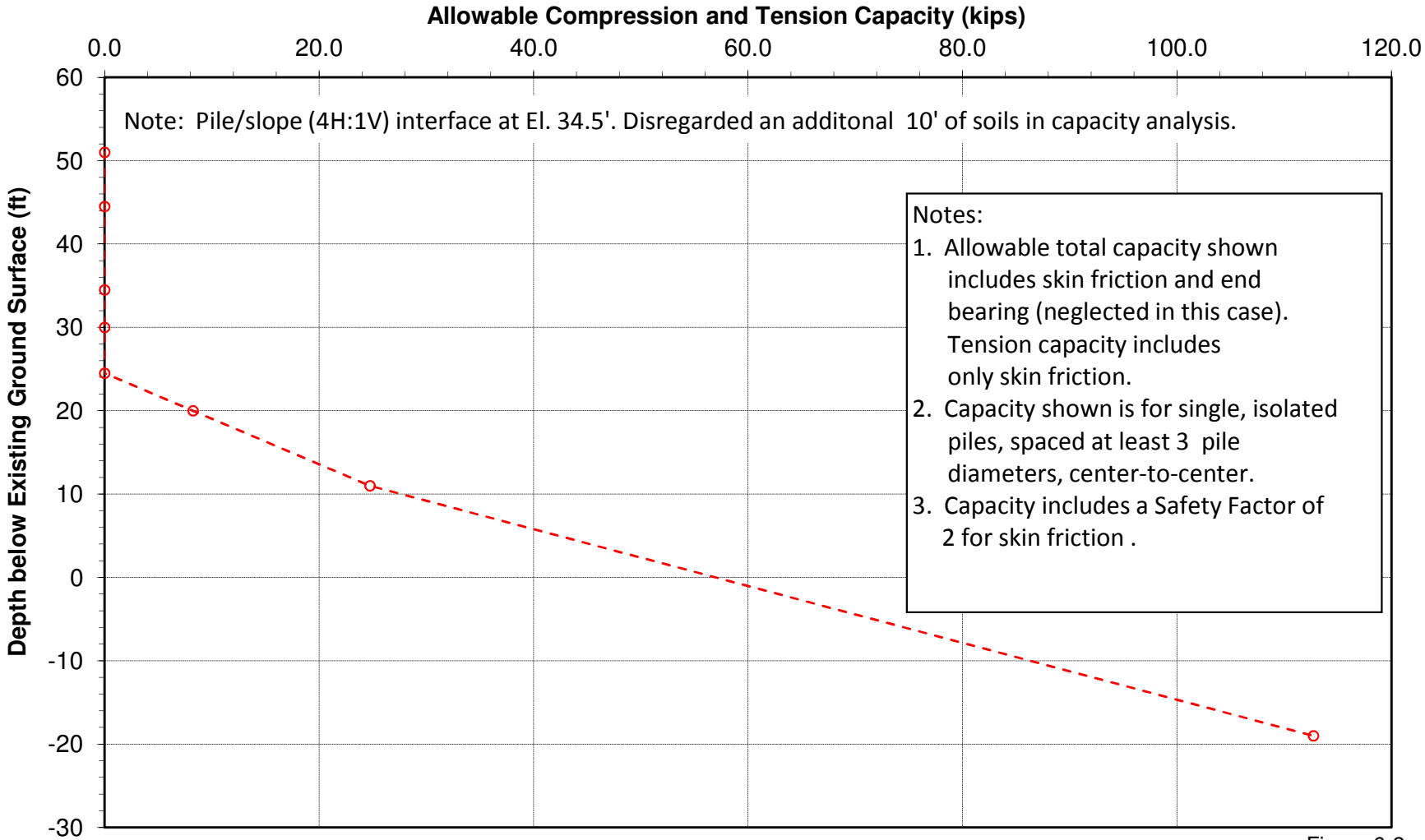


Figure 6-2

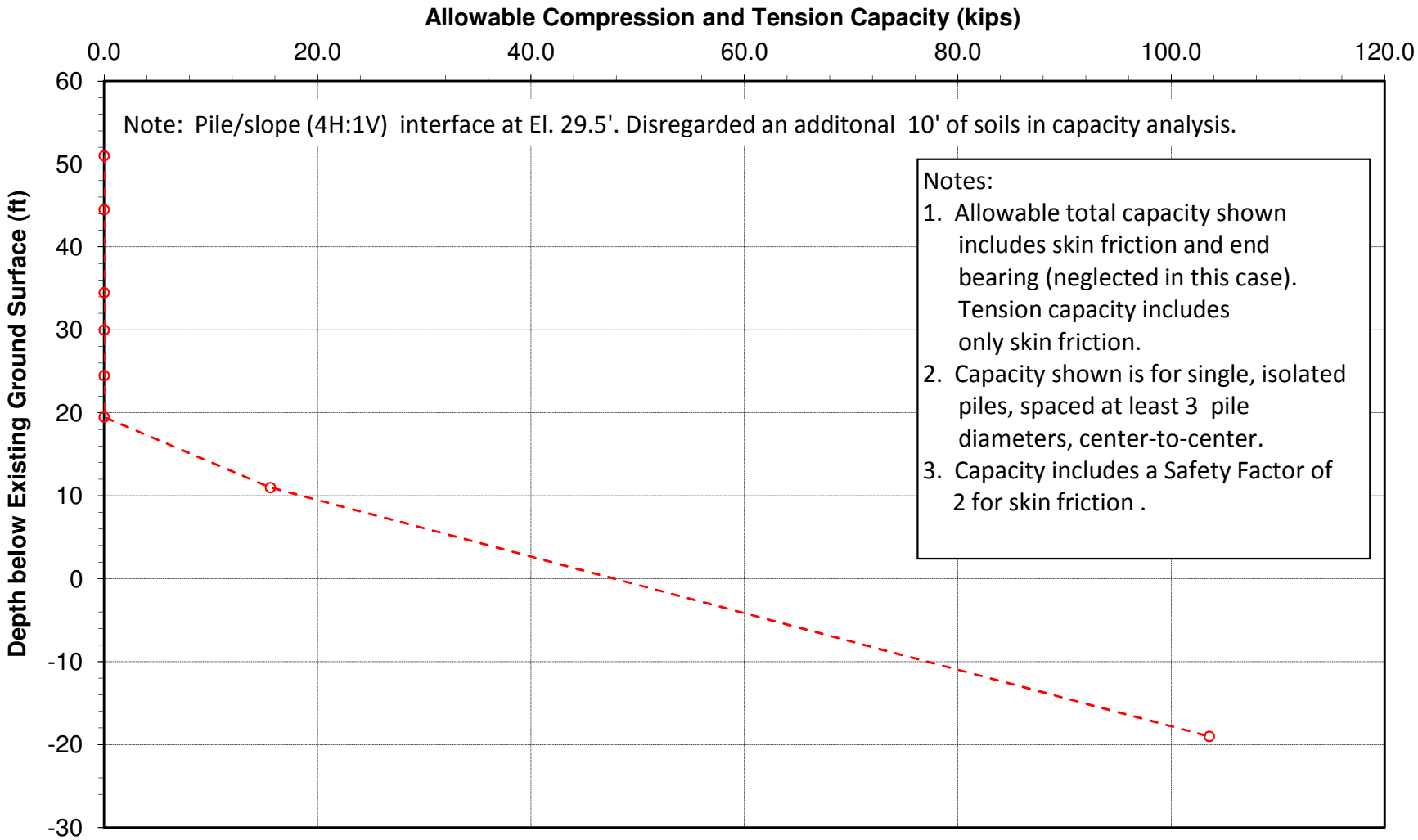

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #3 (Boring B-22)
Allowable Compression and Tension Capacity (kips)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
60
50
40
30
20
10
0
-10
-20
-30
Depth below Existing Ground Surface (ft)
Note: Pile/slope (4H:1V) interface at El. 29.5'. Disregarded an additonal 10' of soils in capacity analysis.
Notes:
1. Allowable total capacity shown includes skin friction and end bearing (neglected in this case). Tension capacity includes only skin friction.
2. Capacity shown is for single, isolated piles, spaced at least 3 pile diameters, center-to-center.
3. Capacity includes a Safety Factor of 2 for skin friction .

Figure 6-3

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #4 (Boring B-22)

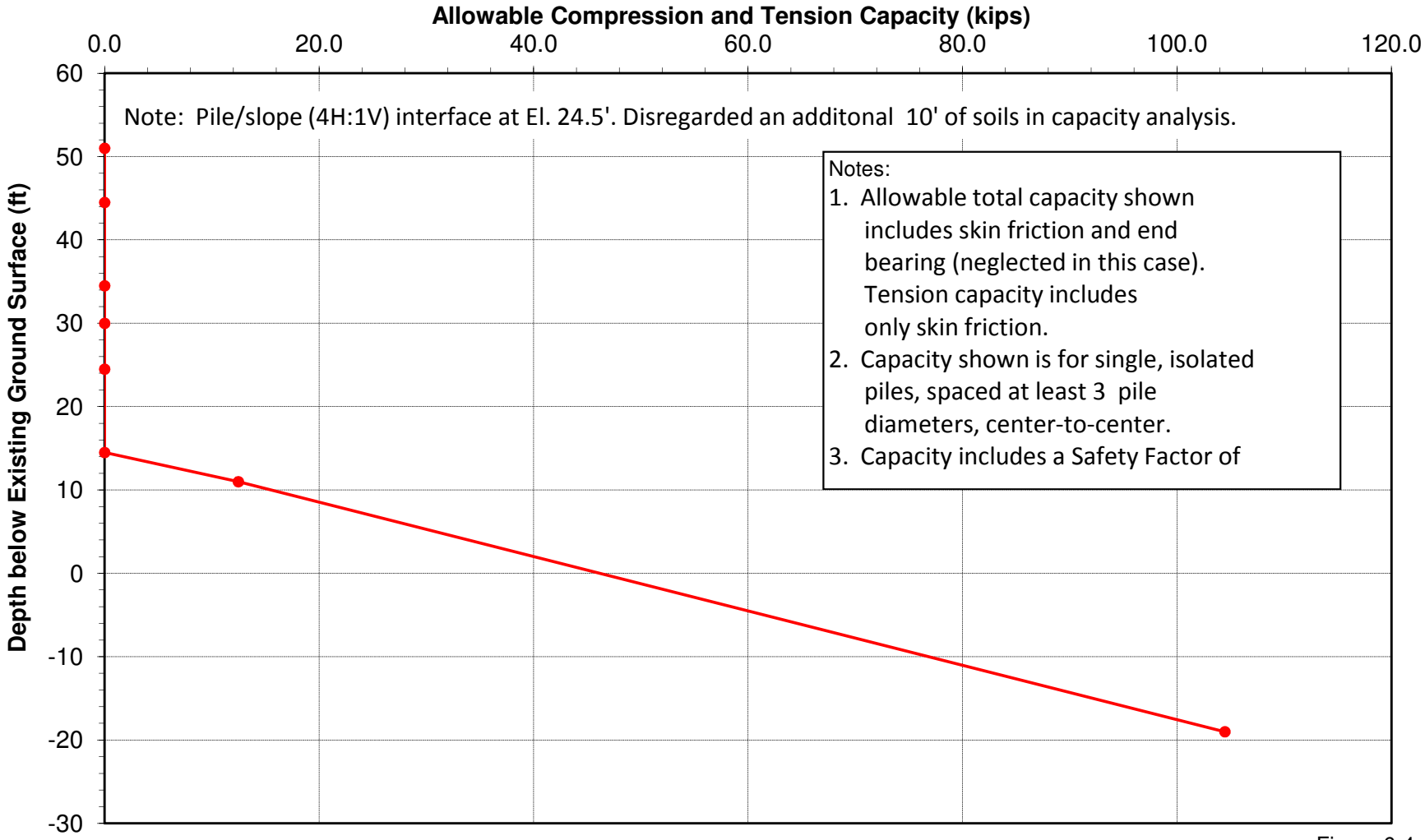


Figure 6-4

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #5 (Boring B-23)

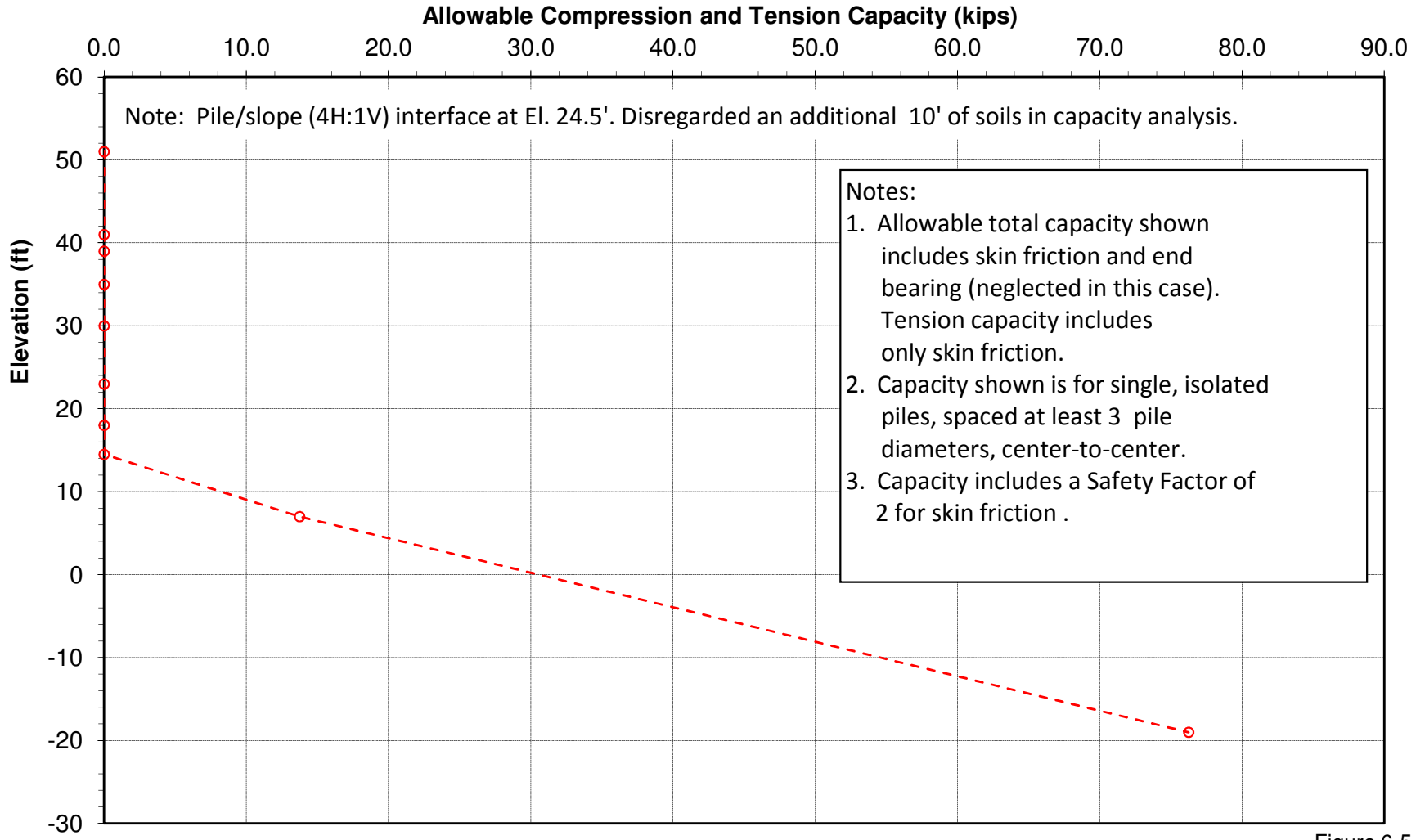


Figure 6-5

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #6 (Boring B-23)

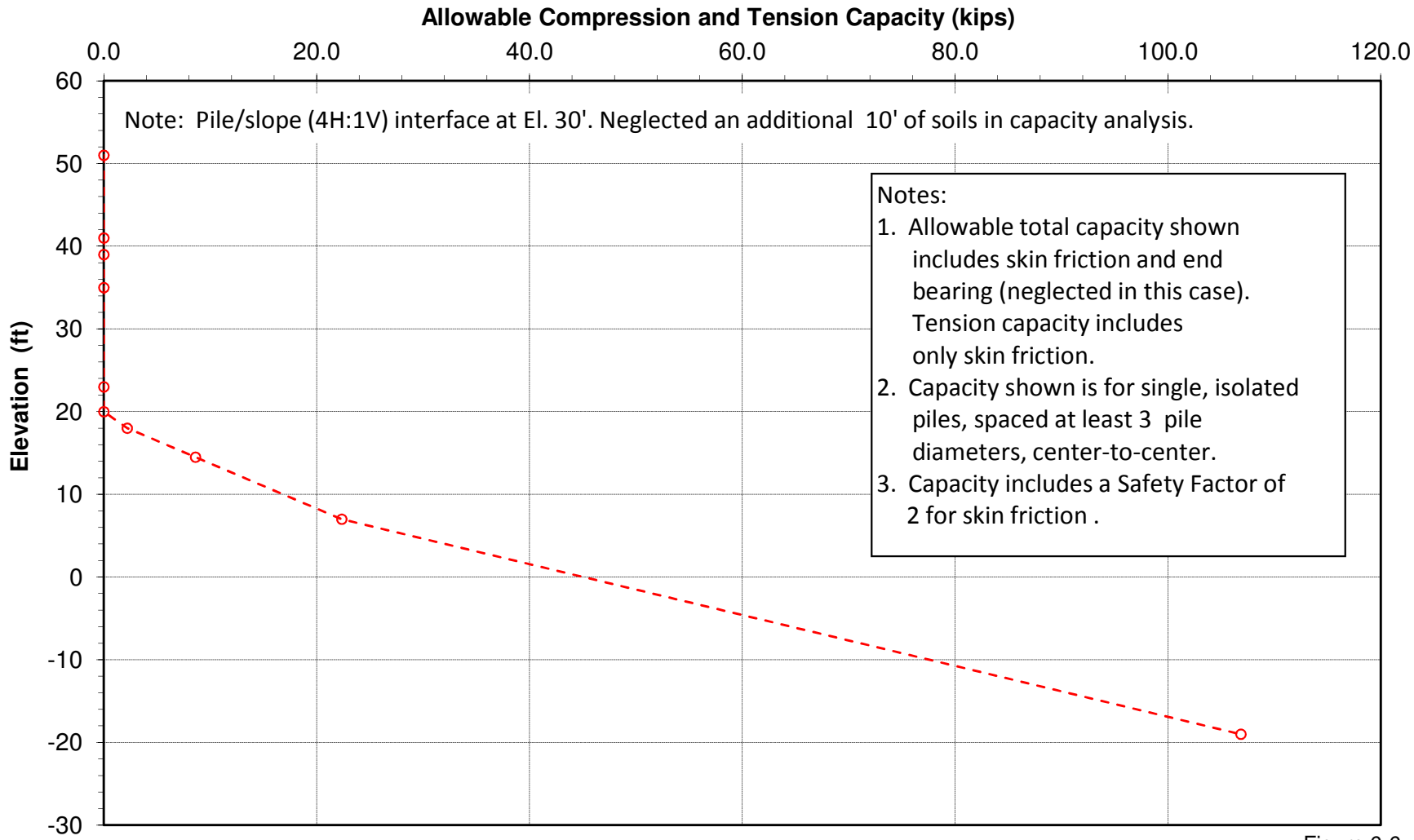


Figure 6-6

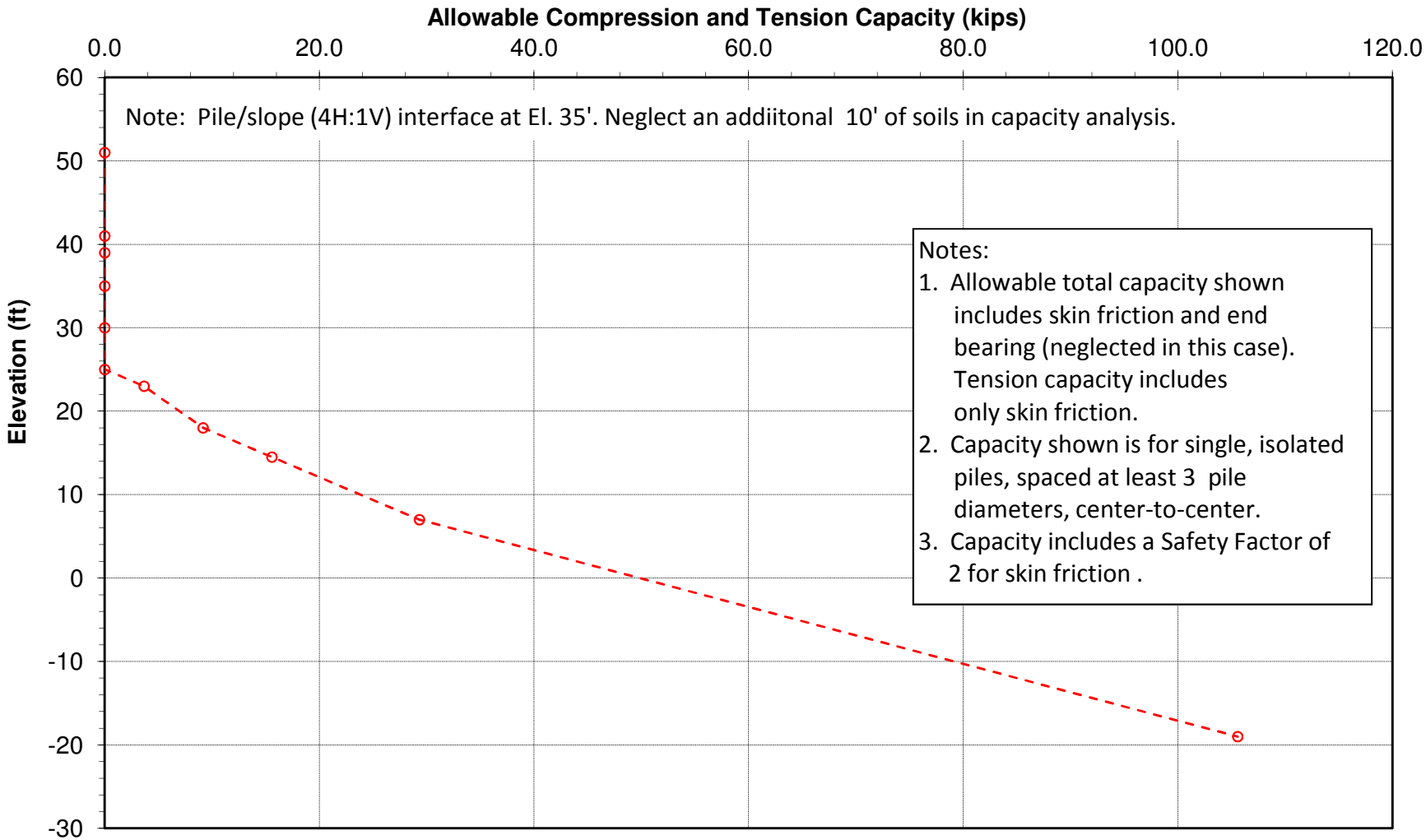

G13-120 Inner Loop North WLR
Water Line Aerial Crossing at Enid Street
16-inch Square Driven Pile: Bent #7 (Boring B-23)
Allowable Compression and Tension Capacity (kips)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Elevation (ft)
60
50
40
30
20
10
0
-10
-20
-30
Note: Pile/slope (4H:1V) interface at El. 35'. Neglect an addiitonal 10' of soils in capacity analysis.
Notes:
1. Allowable total capacity shown includes skin friction and end bearing (neglected in this case). Tension capacity includes only skin friction.
2. Capacity shown is for single, isolated piles, spaced at least 3 pile diameters, center-to-center.
3. Capacity includes a Safety Factor of 2 for skin friction .

Figure 6-7