CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
ENGINEERING AND CONSTRUCTION DIVISION

FINAL GEOTECHNICAL STUDY
WATER LINE REPLACEMENT IN
HUGHES ROAD AREA
WBS NO. S-000035-0187-4
CITY OF HOUSTON, TEXAS

PROJECT NO. 14-320E

TO

QUADRANT CONSULTANTS, INC.
HOUSTON, TEXAS

BY

GEOTECH ENGINEERING AND TESTING

SERVICING

TEXAS, LOUISIANA, NEW MEXICO, OKLAHOMA

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Geotechnical, Environmental, Construction Materials, and Forensic Engineering

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Attention: Mr. Peter R. Jordan, P.E.
Vice President

FINAL GEOTECHNICAL STUDY
WATER LINE REPLACEMENT IN
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Gentlemen:

Submitted here is Geotech Engineering and Testing (GET) geotechnical study of subsurface condition for the above referenced project. The planned facility was discussed in detail with Mr. Peter R. Jordan, P.E. in order to plan a study that would provide the necessary design and construction recommendations. This study was conducted in general accordance with GET Proposal No. P14-109, Revision III, dated May 07, 2014. Authorization to Proceed with this study was received through a Professional Services Agreement between Quadrant Consultants, Inc. and GET on May 08, 2014.

This report presents the results of our geotechnical field exploration and laboratory testing together with recommendations for the design and construction of the proposed water line replacement project. Our recommendations are in general accordance with the City of Houston Standard Construction Specifications for Wastewater Collection Systems, Water Lines and Storm Drainage, dated July 2012.

We appreciate the opportunity to be of service. Should you have any questions or need additional assistance, please call.

Very truly yours,

GEOTECH ENGINEERING AND TESTING
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Appendix A – Site Vicinity Map, Plan of Borings, Soil Stratigraphy profiles, Logs of Borings, Key to Log Terms and Symbols and Summary of Laboratory Test Results
Appendix B – Piezometer Installation and Abandonment Report
Appendix C – Project Alignments Pictures
Appendix D – OSHA Soil Classification

1.0 EXECUTIVE SUMMARY

It is planned to reconstruct approximately 30,990 linear feet of water lines in Hughes Road Area in the City of Houston, Texas. The specific project information is as follows:

Project	Remarks
Water Line Replacement in Hughes Road Area	We understand that eight-inch diameter water lines will be constructed along various streets in the Hughes Road Area in the City of Houston, Texas. The total length of the water lines will be about 30, 990 linear feet. The invert depth of the water lines range from 5- to 12-ft below the existing grade. We understand that the construction technique will be a trenchless method.

This report presents the results of our geotechnical field exploration and laboratory testing together with recommendations for the design and construction of the proposed water lines.

The subsoils and groundwater conditions were evaluated by conducting fifty-one (51) soil test borings (B-1 through B-51) for proposed water line replacement. The soil borings were drilled along the project alignments to depths ranging from 10- to 21-ft below the existing grade. Results of our field investigation and engineering analyses are summarized below:

1. In general, based on our field exploration and laboratory testing data, the soils along the project alignments generally appear to be variable. The soil stratigraphy for the project alignments is summarized as follows:

Stratum No.	Range of Depth, ft.	Soil Type
		CONCRETE PAVEMENT (7.0- to 9.0-inch in thickness)
I	0.6 – 2	FILL: FAT CLAY (CH)
II	0.6 – 2	FILL: LEAN CLAY (CL); In Borings B-11 and B-12 only
III	2 – 21	FAT CLAY (CH)
IV	2 – 10	LEAN CLAY (CL); In borings B-11, B-12 and B-31 only

2. Depth to groundwater will be important for design and construction of the proposed water lines. Water level observations were made during and after about 0.33-hour of drilling. Our short-term field exploration indicates that groundwater was encountered at depths ranging from 14- to 21-ft during and after drilling in Borings B-39, B-46, B-46A and B-49. However, no groundwater was encountered in the remaining borings (Borings B-1 through B-38, B-3A, B-4A, B-40 through B-45, B-47, B-48, B-50 and B-51).

3. Borings B-29 and B-43 were converted to Piezometers PZ-1 through PZ-2, respectively, after completion of drilling. The water reading at Piezometers PZ-1 and PZ-2 indicated that stabilized groundwater level existed at a depth of about 13.0- to 13.5-ft below the existing ground surface.

4. We understand that the water lines will be installed by trenchless construction techniques for this project. Trenchless techniques should be conducted in accordance with the City of Houston Standard Specifications, Section 02447 – Augering Pipe and Conduit. Furthermore, we understand waterlines that will cross HCFCD drainage channels (HCFCD Unit Nos. A120-04-00 and A-120-04-01) be installed using trenchless construction in accordance with the HCFCD Policy, Criteria and Procedure Manual, Section 14.2, October 2010.

5. In order to prevent intolerable movement and overstressing of the pipe, suitable thrust restraint should be provided. Use of restrained joints or thrust blocks is the typical methods of providing reaction for the thrust restraint.

6. The bedding and backfill for the auger pits should be conducted in accordance with the City of Houston Standard Specifications, Section 02317 – Excavation and Backfill for Utilities and Section 02447 – Augering Pipe and Conduit, respectively. Furthermore, the City of Houston Standard Specifications, Drawings No. 02447-01 should be used when backfilling the water lines, auger pits and auger holes.

2.0 INTRODUCTION

It is planned to reconstruct approximately 30,990 linear feet of water lines in Hughes Road Area in the City of Houston, Texas. A site vicinity map is presented on Plate 1. The specific project information is as follows:

Project	Remarks
Water Line Replacement in Hughes Road Area	We understand that eight-inch diameter water lines will be constructed along various streets in Hughes Road Area, City of Houston, Texas. The total length of the water lines will be about 30,990 linear feet. The invert depth of the water lines range from 5- to 12-ft below the existing grade. We understand that the construction technique will be trenchless method.

The scope of our work consisted of conducting a geotechnical study for the project areas and developing recommendations with respect to design and construction of the water lines. Our recommendations are in general accordance with the City of Houston Standard Construction Specification for Wastewater Collection Systems, Water Lines and Storm Drainage, dated July 2012 (Ref. 1). This study was conducted in general accordance with City of Houston Department of Public Works & Engineering, Chapter 11, Geotechnical and Environmental Guidelines, dated July 2012 and HCFCD Policy, Criteria and Procedure Manual, October 2010 (Ref. 2).

This report briefly describes the field exploration and laboratory testing followed by our engineering analyses and recommendations.

3.0 FIELD EXPLORATION

3.1 Pavement Coring

The existing pavement was cored prior to drilling and sampling. The results of pavement coring show that the existing pavement is consist of concrete pavement. The existing pavement thicknesses are presented on Plate 2 and on the respective boring logs. The pavement core locations were patched with ready mix grout.

3.2 Drilling and Sampling

At the request of the client, the soil conditions were explored by conducting fifty-one (51) soil test borings (B-1 through B-51) along the project alignments. The borings locations were discussed with Mr. Peter R. Jordan, P.E. of Quadrant Consultants, Inc. prior to drilling. A summary of boring coordinates, elevations and station number information are presented on Plates 3 and 4. At the request of the City of Houston, three additional borings (B-3A, B-4A and B-46A) were drilled near the ditches. The borings schedule is as follows:

Facility	Boring(s) No.	Boring Depth, ft.
Water Lines	B-1 through B-28, B-3A, B-4A, B-30 through B-38, B-40 through B-42, B-44, B-45, B-47, B-48, B-50 and B-51	10
	B-29*, B-39 and B-43*	16
	B-49	17
	B-46 and B-46A	21

* Borings B-29 and B-43 were converted to Piezometers PZ-1 and PZ-2, respectively.

The borings were drilled along project alignments to depths ranging from 10- to 21-ft below the existing grade. Soil samples were obtained continuously at each boring location from the ground surface to the completion depths of borings ranging from 10- to 21-ft. Approximate boring locations are presented in Appendix A. The cohesive soils were sampled in general accordance with ASTM D 1587.

Soil samples were examined and classified in the field, and cohesive soil strengths were estimated using a calibrated hand penetrometer. This data, together with a classification of the soils encountered and strata limits, is presented on the soil stratigraphy profiles presented in Appendix A. The logs of borings and key to log terms and symbols are also presented in Appendix A.

Depth to groundwater will be important for design and construction of the proposed water lines. For this reason, borings were drilled dry and the depth at which groundwater was first encountered was recorded. Water level observations made during and 0.33-hr after drilling in the borehole are indicated at the bottom portion of the individual logs. The boreholes not converted to piezometers were grouted using tremie method after the completion of the field work.

3.3 Piezometer Installation and Abandonment

Piezometers PZ-1 and PZ-2 were installed to a depth of 16-ft in Borings B-29 and B-43, respectively, after completion of the field work. The piezometers consisted of two-inch diameter PVC riser pipe connected to a 5-ft long section of 0.01-inch slotted well screen. The riser pipe extends to the ground surface and is capped at the top with water tight flush mounted locking cap. After the borings were drilled, the riser pipe and well screen assembly were installed in the boreholes, filter sand was placed in the bottom of the boreholes and in the annulus between the borehole wall and the PVC pipe/screen, and subsequently the boreholes were sealed with bentonite from the top of the filter sand to 2-ft below the existing ground surface and with cement to remaining top 2-ft. The piezometers were developed by using a bailer to purge several volumes of water from the piezometer riser pipe. Water levels were periodically measured to evaluate the stabilized groundwater table. The piezometer installation diagram is shown on Plate 5. A summary of the piezometer readings is presented in the “Piezometer Reading Table” on Plate 6. The piezometers were abandoned in accordance with the TDLR (Chapter 76 of TAC), the City of Houston Design Manual, Item 11.14 - Site Restoration. The piezometer installation and abandonment reports are presented in Appendix B.

4.0 LABORATORY TESTS

4.1 General

Soil classifications and shear strengths were further evaluated by laboratory tests on representative samples of the major strata. The laboratory tests were performed in general accordance with ASTM Standards. Specifically, ASTM D 2487 is used for classification of soils for engineering purposes. Furthermore, summaries of test results are presented in Appendix A.

4.2 Classification Tests

As an aid to visual soil classifications, physical properties of the soils were evaluated by classification tests. The tests were conducted in general accordance with ASTM Standards. These tests consisted of natural moisture content tests (ASTM D 2216 and ASTM D 4643), percent passing No. 200 sieve tests (ASTM D 1140), dry unit weights and Atterberg limit determinations (ASTM D 4318, Method A). Plastic limit test was conducted on all Atterberg limit test samples. Similarity of these properties is indicative of uniform strength and compressibility characteristics for soils of essentially the same geological origin. Results of these tests are tabulated on the boring logs at respective sample depths.

4.3 Strength Tests

Undrained shear strengths of the cohesive soils, measured in the field, were verified by calibrated hand penetrometer, unconfined compressive strength tests (ASTM D 2166) and torvane tests. The test results are also presented on the boring logs.

4.4 Soil Sample Storage

Soil samples tested or not tested in the laboratory will be stored for a period of fourteen days subsequent to submittal of the final report. The samples will be discarded after this period, unless we are instructed otherwise.

5.0 SITE GEOLOGY

According to the soil survey of Harris County, Texas (prepared by the U.S. Department of Agriculture Soil and Conservation Service (1976), geologically the project areas at the proposed alignment lies on Lake Charles-Urban Land Complex (Lu) and Lake Charles Clay, 0 to 1 percent slopes (LcA). The geologic character of each soil type is described below:

Lake Charles-Urban Land Complex (Lu) – This is a nearly level complex in broad, irregular areas that range from 20 acres to about 1,800 acres in size. Slopes are mainly 0 to 1 percent, but range from 0 to 3 percent in some areas leading to drainage ways. Lake Charles soils make up 20 to 85 percent of this unit; Urban land, 10 to 75 percent; and other soils, 15 percent or less. The areas making up this complex are so intricately mixed that separation was not feasible at the scale used in mapping.

The surface layer of the Lake Charles soil is about 36 inches thick. In the upper 22 inches it is very firm, neutral, black clay. In the lower 14 inches it is very firm, mildly alkaline, very dark gray clay. In the layer below that it is about 16 inches thick and is very firm, mildly alkaline, dark gray clay that has intersecting slickensides. The next layer, to a depth of 74 inches, is very firm, mildly alkaline, gray clay that has mottles of olive brown and yellowish brown.

Urban land consists of soils that have been altered or covered by buildings or other urban structures. Classifying these soils is not practical. Typical structures are single- and multiple-unit dwellings, streets, schools, churches, parking lots, office buildings, and shopping centers that are less than 40 acres in size. The Urban land includes remnants of Lake Charles soils that have been altered by cutting, filling, and grading in urban development. In many areas of this mapping unit 6 to 18 inches of fill material covers the natural soil. Included with this complex in mapping are small areas of Beaumont, Bernard, Midland, and Vamont soils. This mapping unit has severe limitations for urban development. The main limitation is the high shrink-swell potential of the clay, which results in buckled streets and sidewalks and cracked walls. Lawns and gardens are difficult to establish because of the high clay content of the soils.

Lake Charles clay, 0 to 1 percent slopes (LcA) – This is a nearly level soil in broad, irregular areas that are 50 to several hundred areas in size. Slopes average 0.2 percent.

In the center of the micro depressions, the surface layer is about 36 inch thick. In the upper 22 inches it is very firm, neutral, black clay. In the lower 14 inches it is very firm, mildly alkaline, very dark gray clay. The layer below that is about 16 inches thick and consists of very firm, mildly alkaline, dark gray clay that has intersecting slickensides. The next layer, to a depth of 74 inches, is very firm, mildly alkaline, gray clay that is mottled olive brown and yellowish brown.

Included in this soil in mapping are small areas of Beaumont, Bernard, Midland, Addicks and Vamont soils and a few areas of this soils that are adjacent to Harris clay and that are slightly saline. These inclusions make up less than 10 percent of any mapped area.

This soil is somewhat poorly drained. Surface runoff is very slow. Permeability and internal drainage is very slow. The available water capacity is high. When this soil is fry, deep wide cracks form on the surface. Water enters rapidly through the cracks form on the surface. Water enters rapidly through the cracks, but it enters very slowly when the soil is wet and the cracks are sealed.

6.0 GENERAL SOILS AND DESIGN CONDITIONS

6.1 Site Conditions

The project alignments are generally flat and exhibit a topographic variation of less than three-ft. Currently, most of the project alignments are along the paved roadways. In general, residential and commercial structures are located along the project alignments. Pictures of the project areas were taken during our site visit. These pictures are presented on Appendix C.

6.2 Soil Stratigraphy

Field and laboratory test data indicate that soil stratigraphy along the project alignments are relatively uniform. Details of subsoil conditions at each boring location are presented on the respective boring logs. In general, the soil can be grouped into four (4) major strata with depth limits and characteristics as follows:

Stratum No.	Range of Depth, ft.	Soil Description*
		CONCRETE PAVEMENT (7.0- to 9.0-inch in Thickness)
I	0.6 – 2	FILL: FAT CLAY, soft to hard, light gray, light brown, brown, gray, dark gray, with root fibers, ferrous and calcareous nodules, moist (CH)
II	0.6 – 2	FILL: LEAN CLAY, very stiff, dark gray with root fibers, ferrous nodules (CL) ; In Borings B-11 and B-12 only
III	2 – 21	FAT CLAY, soft to hard, light gray, gray, dark gray, light brown, brown, reddish brown, dark brown, with ferrous and calcareous nodules, moist (CH)
IV	2 – 10	LEAN CLAY, very stiff to hard, light gray, gray, dark gray, reddish brown, with ferrous nodules, sands, moist (CL) ; In Borings B-11, B-12 and B-31 only

* Classification in general accordance with the Unified Soil Classification System (ASTM D 2487)

6.3 Soil Properties

Soil strength and index properties and how they relate to the water lines installation along the project alignments are summarized below:

Stratum No.	Soil Type	PI(s)	Soil Expansivity	Soil Strength, tsf
I	Fill: Fat Clay (CH)	34 – 56	Expansive to Highly Expansive	0.15 – 2.06
II	Fill: Lean Clay (CL)	–	–	1.50
III	Fat Clay (CH)	34 – 75	Expansive to Highly Expansive	0.25 – 2.50
IV	Lean Clay (CL)	23 – 30	Moderately Expansive	1.50 – 2.50

Legend: PI = Plasticity Index

6.4 Water-Level Measurements

The soil borings were first drilled dry to evaluate the presence of perched or free-water conditions. The levels where free water was encountered in the open boreholes during and about 0.5-hour after drilling are shown on the boring logs. Our groundwater measurements are summarized below:

Boring No.	Groundwater Depth, ft. at the Time of Drilling	Groundwater Depth, ft. at about 0.33 Hour Later
B-1 through B-38, B-3A, B-4A, B-40 through B-42, B-45, B-47, B-48, B-50 and B-51	Dry	Dry
B-39 and B-49	15	15
B-46	14	14
B-46A	21	21

Fluctuations in groundwater generally occur as a function of seasonal moisture variation, temperature, groundwater withdrawal and future construction activities that may alter the surface drainage and subdrainage characteristics of this site.

An accurate evaluation of the hydrostatic water table in the relatively impermeable clays and low permeable sands/silts requires long term observation of monitoring wells and/or piezometers. It is not possible to accurately predict the pressure and/or level of groundwater that might occur based upon short-term site exploration. In view of this, Borings B-29 and B-43 were converted to Piezometers PZ-1 and PZ-2, respectively, after the completion of the field work. The piezometer readings are presented on Plate 6.

We recommend that GET be immediately notified if a noticeable change in groundwater occurs from that mentioned in our report. We would be pleased to evaluate the effect of any groundwater changes on our design and construction sections of this report.

7.0 WATER LINES

7.1 General

We understand that the invert depths of water lines will be ranging from 5- to 12-ft below the existing grade. Furthermore, trenchless method will be used for the water lines installations. Soil Borings B-1 through B-51 were drilled along the alignments of the water lines to the depths ranging from 10- to 21-ft below the existing grade. The borings schedule is presented in the "Field Exploration" in Section 3.0 of this report. The approximate boring locations are presented in Appendix A. We understand that the proposed water lines will be constructed according to the City of Houston Specifications, Section 02447 – Augering Pipe and Conduit. Furthermore, we understand that the proposed waterlines will be installed beneath HCFCD drainage channel (HCFCD Unit Nos. A120-04-00 and A-120-04-01) using trenchless construction in accordance to HCFCD Policy, Criteria and Procedure Manual, Section 14.2, October 2010 (Ref. 2).

7.2 Trenchless and Trenchless Pits Method

We understand that trenchless method will be used for this project. The trenchless method should be conducted in accordance with the City of Houston Standard Specifications, Section 02447 – Augering Pipe and Conduit.

Trenchless method should be started from approved pit locations. Excavation for pits and shoring installation should conform to the aforementioned City of Houston Standard Specifications, Section 02317 – Excavation and Backfill for Utilities. The designing, constructing and maintaining safe excavations are the responsibility of the contractor. Detailed guidelines for trenchless pit excavations are presented in "Excavation" in Section 8.5 of this report.

If the trenchless zone is within the cohesionless soils or caving soils, install casing as required by the City of Houston Standard Specifications, Section 02447 – Augering Pipe and Conduit. The augering near existing structures or utility lines should be conducted in accordance with the City of Houston Standard Specifications. Diameter of auger hole should not exceed pipe bell diameter plus 2-inch. The receiving pit distance should conform to the aforementioned City of Houston Standard Specifications. A minimum spacing of 6-inch should be provided between the pipe and walls of bore pit. The maximum allowable width of pit shall be 5-ft unless approved by the engineer. Width of pit at surface shall not be less than the pit width at the bottom.

7.3 Trenchless Installation at HCFCD Drainage Channel Crossing

We understand the proposed water lines will be installed beneath HCFCD drainage channel (HCFCD Unit Nos. A120-04-00 and A-120-04-01) using trenchless construction.

7.3.1 HCFCD Criteria

Based on the information provided in Section 14.2 of the October 2010 HCFCD Policy, Criteria, and Procedure Manual, a minimum soil cover of 5-ft is required below the mudline for the proposed waterline that crosses the drainage channel. The actual cover may need to be greater than 5 feet to reduce the potential for pipe exposure due to scouring and/or erosion of the soils at the bottom of the channel.

7.3.2 Recommended Depths of Installation

The soil beneath the anticipated mudline depth for the drainage channel consists of fat clay soils. It is recommended that the soil cover below the mudline be at least 5-ft to protect against potential scouring.

We also recommended periodic monitoring to evaluate if the minimum soil cover in accordance with HCFCD design criteria exists during the life of the proposed waterline.

7.4 Groundwater Control

Our short-term field exploration indicates that groundwater was encountered at depths ranging from 14- to 21-ft during and after about 0.33-hour of drilling in borings B-39, B-46, B-46A and B-49. However, no groundwater was encountered in the remaining borings. Furthermore, the results of Piezometers PZ-1 and PZ-2 indicated that stabilized groundwater level exist at a depth of ranging from 13.0-to 13.5-ft below the existing ground surface. Therefore, groundwater dewatering may be required. A detailed groundwater control recommendations are presented in "Groundwater Control" in Section 8.3 of this report.

7.5 Loads Imposed on Buried Pipes

7.5.1 General

The loads on an underground pipe depend principally upon the weight of overburden soils, roadway and loads due to surcharges. For design of concrete pressure pipe, linear load due to overburden can be determined based on the design tables and charts presented in the "AWWA Manual of Water Supply Practices Concrete Pressure Pipe (AWWA M9)" developed by the American Concrete Pipe Association. Overburden pressure for the buried pipes at the project alignments are estimated by using the soil density (γ) and the height of the soil over the pipe (H).

7.5.2 Loads Due to Overburden Pressure

Overburden or prism load for buried pipes is given by the following equation:

$$P = \gamma H$$

Where: P = Load due to weight of soils at depth, psf
γ = Total Unit weight of soil, 125 pcf
H = Height of the soil over the pipe, ft

Loadings per linear foot of pipe:

$$W_e = C_d\, \gamma (B_d)^2 \text{ (Marston Equation)}$$

$$C_d = \frac{1 - e^{-2ku'\left(\frac{H}{B_d}\right)}}{2ku'}$$

Where: W_e = Load, pounds per linear foot (lb/ft)
B_d = Trench width (ft)
C_d = Load Coefficient
k = Friction angle between backfill and soil
u' = Coefficient of friction between fill material and sides of trench
ku' = for sand = 0.165
for clay = 0.130
for saturated clay = 0.110

7.5.3 Piping System Thrust Restraint

Fittings on underground pipes are subject to thrust forces inherited from the fluid pressure in the pipe and are directly proportional to the fluid pressure. Unbalance thrust forces will be developed in pressure pipelines due to changes in direction, cross-sectional areas, or when the pipe is terminated. These forces may cause joints to disengage if not adequately restrained. There will be a slight loss of head due to turbulence friction in bends of the pipes. This loss will cause a pressure change across the bend, but it is usually small enough to be neglected.

The thrust force may require more reaction than is available just from the pipe bearing against the backfill. In order to prevent intolerable movement and overstressing of the pipe, suitable buttressing should be provided. In general, thrust blocks, restrained joints and tie rods are common methods of providing reaction for the thrust restraint design. The thrust restraint design provisions described in this section are based on the American Water Works Association Manual M9 (1996)-Concrete Pressure Pipe.

The force diagram shown on Plate 8 illustrates the thrust force generated by flow at a bend in the pipe. The equations for computing this thrust force are also given on this plate. The values of thrust force for a surge pressure of 50 psi were computed for a bend angle of 90 degrees. Results are presented on Plate 7. Once the size of the thrust is determined, a thrust block size can be calculated based on the bearing capacity of the soil. The area of block required is equal to the thrust force (lb) divided by the safe bearing value of the soil (psf). In cohesive soils, the safe bearing value is equal to 2/3 of the average shear strength of the soil adjacent to the block which includes a factor of safety of 3. We believe that a factor of safety of 3 is appropriate in order to limit deflections required to mobilize the passive resistance within tolerable values.

For granular soil encountered at this site, a safe bearing value for thrust blocks can be taken as 90% of the effective overburden pressure at the mid height of the thrust block which includes a factor of safety of 3. The effective overburden pressure can be calculated based on the effective unit weight of the soil above the mid-height of the thrust block.

Geotechnical design parameters for designing the necessary buttressing are as follows:

γ : Wet unit weight of soil − above water level : 125 pcf
Submerged unit weight of soil − below water level : 60 pcf
c : Cohesion = 1000 psf (for clay)
ϕ : Angle of internal friction = 30 degrees (for sand)

7.6 Backfilling for Trenchless Pits and Trenchless Holes

Sand used in backfill sections should be free of clay lumps, organic materials, or other deleterious substances, and should have a PI less than 7, and not more than 15% passing the No. 200 sieve.

Backfill should be placed in accordance with the City of Houston Specifications, Section 02317 – Excavation and Backfill for Utilities. City of Houston Standard Specifications Drawing No. 02447-01 should be followed when backfilling the auger pits. The annular space between the pipe and the auger hole should be backfilled to a minimum of 12-inch on both sides beyond the auger pit as indicated in the City of Houston Standard Specifications Drawing No. 02447-01.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Site Preparation

If needed, site preparation for the proposed water lines construction should be conducted in accordance with the City of Houston Standard Specifications, Section 02221 – Removing Existing Pavements and Structures and Section 02233 – Clearing and Grubbing. In general, subgrade preparation, if needed, should be as follows:

1. The requirement for removal of any existing paving, and subsoil materials will depend on final grades and other alignment information. In general, remove all vegetation, tree roots, organic topsoil, existing foundations, paved areas and any undesirable materials from the construction area. Tree trunks under the construction areas should be removed to a root size of less than 0.5-inch. We recommend that the stripping depth be evaluated at the time of construction by a soil technician.

2. The subgrade areas should then be proofrolled with a loaded dump truck or similar pneumatic-tired equipment with loads ranging from 25- to 50-tons. The proofrolling serves to compact surficial soils and to detect any soft or loose zones. The proofrolling should be conducted in accordance with TxDOT Standard Specifications Item 216. Any soils deflecting excessively under moving loads should be undercut to firm soils and recompacted. Any subgrade stabilization should be conducted after site proofrolling is completed and approved by the geotechnical engineer. The proofrolling operation should be observed by an experienced geotechnician.

3. The cohesionless soils (if encountered) are moisture sensitive, compressible and are difficult to compact in a wet condition (they may pump). These soils can be modified, using 5% to 10% Fly-ash. The Fly-Ash stabilization should be in accordance with the City of Houston Standard Specifications, Section 02337 – Lime/Fly Ash Stabilized Subgrade.

4. Off-site borrow for structural fill should consist of lean clays with a liquid limit not exceeding 45 and a PI between 8 and 20. These soils should be placed in loose lifts not exceeding eight-inch and compacted to at least 95% of maximum standard density (ASTM D 698) at a moisture content between optimum and 3%. Bank sands should not be used as select structural fill. On-site soils, free of organics and lime treated as discussed in Section 8.2.5 of this report (with the exception of sands and silts) are also suitable for use as structural fill. Off-site borrow should be in accordance with the City of Houston Standard Specifications, Section 02319 – Borrow.

5. In cut areas, the soil should be excavated to grade and the surficial soil proofrolled and scarified to a minimum depth of six-inch and recompacted to the previously mentioned density and moisture content.

6. Positive site drainage should be developed at the beginning of the project to limit construction difficulties with wet surface soils.

8.2 Suitability of On-Site Soils for Use as Fill

8.2.1 General

Fill requirements should be in accordance with the City of Houston Standard Specifications Section 02316 –Excavation and Backfill for Structures, Section 02317 – Excavation and Backfill for Utilities and Section 02320 – Utility Backfill Materials. The on-site soils can be used as fill materials as described in the following report sections.

8.2.2 Select Backfill

This is the type of fill that can be used for the structures or utilities. These soils should consist of lean clays with plasticity indices between 8 and 20 and amount of passing No. 200 sieve greater than 50 percent.

8.2.3 Random Backfill

This type of fill does not meet the Atterberg limit requirements for select structural fill. This fill should consist of lean clays or fat clays. They can be used for the structures or utilities after treatment.

8.2.4 General Fill

This type of fill could consist of silts, sands, clays or organic clays. However, the silts and sands are moisture sensitive and are difficult to compact in a wet condition (they may pump). Furthermore, these soils can erode easily. Their use is not recommended as backfill materials. They can be used for site grading and in unimproved areas.

8.2.5 On-Site Fill Soil Classification

Based on Borings B-1 through B-51, the on-site soils can be used as fill materials as described below:

Stratum No.[1]	Soil Type	Use as Fill: Select Structural Fill	Use as Fill: Structural Fill	Use as Fill: General Fill	Notes
I	Fill: Fat Clay (CH)	–	✓	✓	2, 3
II	Fill: Lean Clay (CL)	–	✓	✓	2, 4
III	Fat Clay (CH)	–	✓	✓	2, 3
IV	Lean Clay (CL)	–	✓	✓	2, 4

Notes:

1. See soil stratigraphy and design conditions sections of this report for strata description.
2. All fill soils should be free of organics, roots, etc.
3. These soils, once lime modified (8% by dry weight), can be used as select structural fill.
4. These soils, once lime modified (5% by dry weight), can be used as select structural fill.

8.3 Groundwater Control

8.3.1 General

We understand that the invert of the proposed water lines will be founded at depths ranging from 5- to 12-ft below the existing grade. Our short-term field exploration indicates that groundwater was encountered at depths ranging from 14- to 15-ft during and after 0.5-hr of drilling in Borings B-39, B-46 and B-49. However, no groundwater was encountered in the remaining borings. Furthermore, the results of Piezometers PZ-1 and PZ-2 indicated that stabilized groundwater level exist at a depth ranging from about 13.0-to 13.5-ft below the existing ground surface. Therefore, groundwater dewatering may be required.

Fluctuation in groundwater can occur as a function of seasonal moisture variation. Groundwater control recommendations are presented in the following report sections.

8.3.2 Dewatering Technique

In the event that groundwater is encountered during construction, it is our opinion that groundwater should be lowered to a depth of at least three-ft below the deepest excavation grade in order to provide dry working conditions and firm bedding. Any minor water inflow in cohesive soil layers can probably be removed using a sump-pump or trench sump-pump. Wellpoint system can be used in the area where sands are present.

The design of dewatering system should consider the amount of groundwater to be lowered and the permeability of the affected soils. The selection and proper implementation of an effective groundwater control system is the responsibility of the contractor. The design of dewatering system for groundwater and surface water control should be in accordance with the City of Houston Specifications, Section 01578 − Control of Ground Water and Surface Water.

8.4 OSHA Soil Classifications

The subsoils can be classified in accordance with the Occupational Safety and Health Administration (OSHA) Standards, dated October 31, 1989 of the Federal Register. OSHA classification system categorizes the soil and rock in four types based on shear strength and stability. The description of four (4) types in the classification system is summarized in the Appendix D.

Based on our geotechnical exploration and laboratory test results, details of soil classifications at each boring are summarized in the OSHA Soil Classifications, presented in Appendix D. Furthermore, a letter for the trench safety recommendations is provided separately.

8.5 Excavations

If open excavation or trench, five-ft or deeper is needed, each side of the excavation or trench must be protected by sheeting/bracing shoring or sloped. Based on the soil strength data and OSHA soil classifications, temporary (less than 24 hours) open-trenched, non-surcharged, and unsupported excavations should be made on slopes of about 1.5(h):1(v). Vertical cuts can be constructed, provided shoring and bracing are used for the excavation wall stability. Benched excavation can also be used with average slopes of about 1(h):1(v) and steps should not be higher than five-ft. In all cases, excavations should conform to OSHA guidelines. Flatter slopes may have to be used if large amounts of sand need to be excavated for deep utility installations. Specifications should require that no water be allowed to pond in the excavations. The surface slopes should be protected from deterioration and weathering if they are to be left open for more than 24 hours. It is our opinion that the method means and sequence of construction excavation should be the responsibility of the contractor.

Excavations should be performed with equipment capable of providing a relatively clean bearing area. Excavation equipment should not disturb the soil beneath the design excavation bottom and should not leave large amounts of loose soil in the excavation.

8.6 Lateral Earth Pressures

In the event that open excavations are not used, the proposed water lines can be installed using trench sheeting. The sheeting can be constructed in the form of cantilever sheeting or with bracing. Lateral earth pressures for each method used are summarized on Plate 8. The trenching and shoring operations should follow OSHA Standards. We recommend a geotechnical engineer monitor all phases of trench excavation and bracing to assure trench safety.

8.7 Surface Water Drainage

In order to minimize pounding of surface water, site drainage should be established early in project construction so that this condition will be controlled.

8.8 Earthwork

Difficult access and workability problems can occur in the surficial clay fill soils due to poor site drainage, wet season, or site geohydrology. Should this condition develop, drying of the soils for support of pavement and floor slabs may be improved by the addition of 8% lime by dry weight. The application rate corresponding to this additive amount would be approximately 36 pounds per square yard for each six-inch of compacted thickness.

City of Houston Standard Specifications 02336 shall be used as procedural guides for placing, mixing, and compacting lime stabilizer and the soils.

Our recommendations on subgrade stabilization are preliminary. The actual depth and type of stabilization should be determined in the field at the time of construction just after site stripping and proofrolling. The required amount of lime for stabilization should be determined by ASTM C 977 Method. Furthermore, the type and amount of the stabilizer may vary depending on the final grade elevation and the soil type encountered.

Provided the site work is performed during dry weather and/or project schedules permit aeration of wet soils, the subgrade will be suitable for floor slab and pavement support.

8.9 Construction Surveillance

Construction surveillance and quality control tests should be planned to verify materials and placement in accordance with the specifications. The recommendations presented in this report were based on a discrete number of soil test borings. Soil type and properties may vary across the site. As a part of quality control, if this condition is noted during the construction, we can then evaluate and revise the design and construction to minimize construction delays and cost overruns. We recommend the following quality control procedures be followed by a qualified engineer or technician during the construction of the facilities:

- Monitor all phases of trench safety (if trench is used).
- Observe the site stripping and proofrolling.
- Verify the type, depth and amount of stabilizer.
- Verify the compaction of subgrade soils and backfill soils.
- Evaluate the quality of fill and monitor the fill compaction for all lifts.
- Observe the foundation make-up prior to concrete placement.
- Monitor and test the excavations for strength, cleanness, depth, size, etc.
- Observe all excavation operations.
- Monitor concrete placement, conduct slump tests and make concrete cylinders

It is the responsibility of the client to notify GET when each phase of the construction is taking place so that proper quality control and procedures are implemented.

9.0 RECOMMENDED ADDITIONAL STUDIES

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that civil engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. We recommend that GET be retained to review the plans and specifications to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted as intended.

10.0 STANDARD OF CARE

The recommendations described herein were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical engineering profession practicing contemporaneously under similar conditions in the locality of the project. No other warranty or guarantee, expressed or implied, is made other than the work was performed in a proper and workmanlike manner.

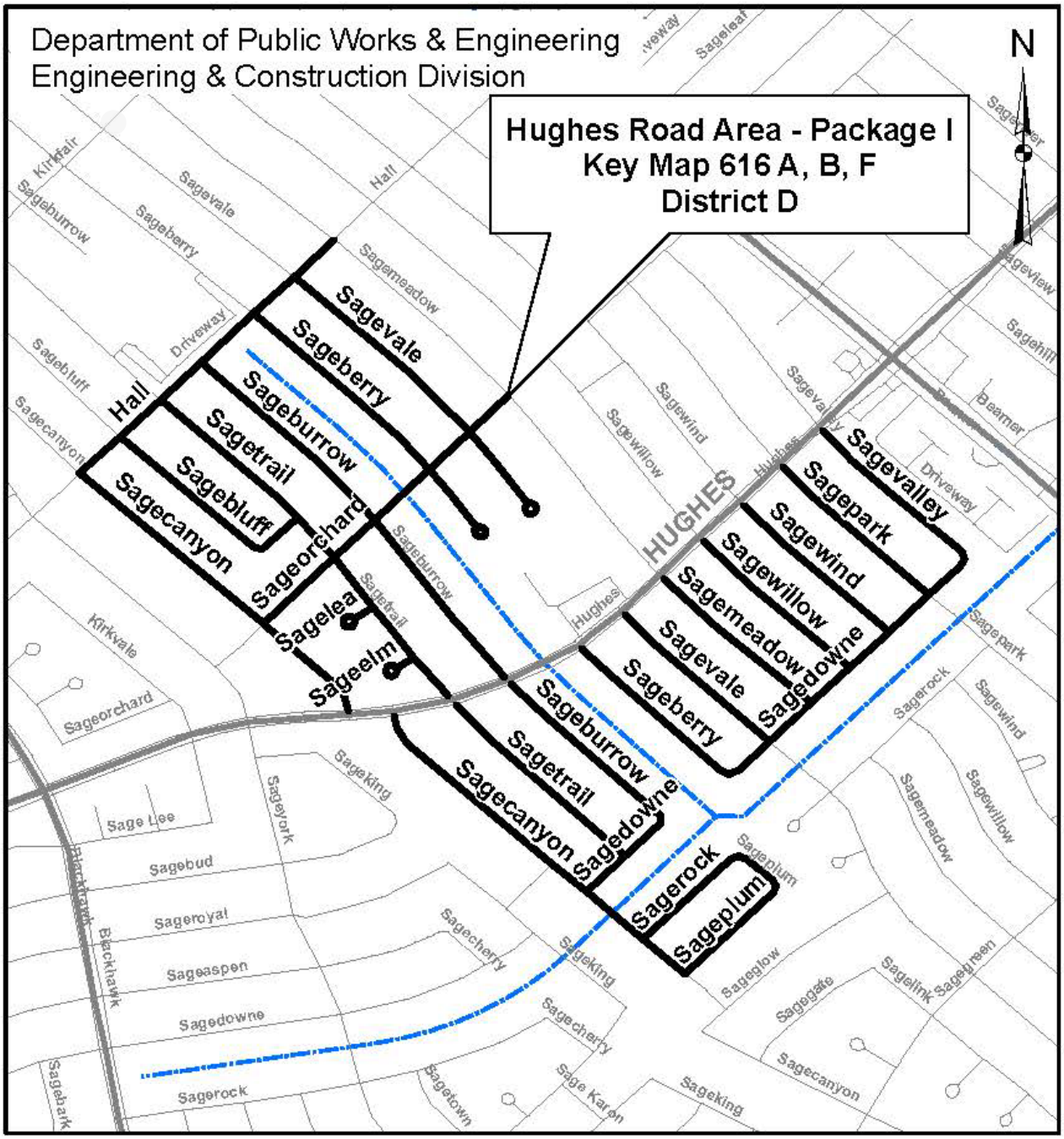
11.0 REPORT DISTRIBUTION

This report was prepared for the sole and exclusive use by our client (Quadrant Consultants, Inc.) and owner (City of Houston), based on specific and limited objectives. All reports, boring logs, field data, laboratory test results, maps and other documents prepared by GET as instruments of service shall remain the property of GET. GET assumes no responsibility or obligation for the unauthorized use of this report by other parties and for purposes beyond the stated project objectives and work limitations.

12.0 REFERENCES

1. "Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage, Street Paving and Traffic", Department of Public Works and Engineering, City of Houston, July 2012.

2. "Harris County Flood Control District Policy, Criteria, and Procedure Manual", by Harris County Flood Control District, 2010.



SITE VICINITY MAP

PROJECT: Geotechnical Study, Proposed Water Lines Replacement in Hughes Road Area
WBS No. S-000035-0187-4, City of Houston, Texas

SCALE: 1"=600'	DATE: NOVEMBER 2015	PROJECT NO.: 14-320E

NORTH

EXISTING CONCRETE PAVEMENT THICKNESS

Core/Boring Locations	Thickness, inches
C-1/B-1, C-2/B-2 and C-4/B-4 through C-51/B-51	7.0
C-3/B-3	9.0

SUMMARY OF BORING LOCATIONS

Boring No.	Alignment	Northing	Easting	Elevation	Station No.	Offset (ft.)
B-1	Sagecanyon Dr.	13781760.63	3166936.51	33.19'	2+84.37	5.97L
B-2	Sagecanyon Dr	13781510.61	3167202.77	34.00'	6+52.52	6.88L
B-3	Sagecanyon Dr	13780872.96	3167922.50	33.04'	16+14.08	6.46L
B-4	Sagecanyon Dr	13780719.89	3168092.20	32.43'	18+42.61	4.32L
B-5	Sugeplum Dr.	13780628.19	3168493.84	32.52'	3+26.91	5.06R
B-6	Sugeplum Dr.	13780963.61	3168780.34	32.48'	7+67.77	3.34R
B-7	Sagerock Dr.	13780808.67	3168267.63	32.59'	3+12.06	3.83L
B-8	Sagetrail Dr.	13781351.06	3167803.45	32.91'	32+19.69	5.56L
B-9	Sagetrail Dr.	13781610.33	3167518.11	33.24'	28+33.89	5.67L
B-10	Sageburrow Dr.	13781543.29	3168005.13	33.35'	32+16.29	3.18L
B-11	Sageburrow Dr.	13781886.06	3167635.46	32.60'	27+11.81	4.86L
B-12	Sageberry Dr.	13781725.10	3168376.22	34.26'	9+70.92	4.58L
B-13	Sageberry Dr.	13782124.53	3167937.36	33.68'	3+77.15	6.21L
B-14	Sagedown Ln.	13781827.14	3168683.68	33.68'	11+33.61	2.84L
B-15	Sagevale Dr.	13782064.13	3168415.40	34.06'	7+44.76	4.48L
B-16	Sagemeadow Dr.	13782220.46	3168662.17	33.00'	8+49.81	5.08L
B-17	Sagemeadow Dr.	13782534.17	3168317.98	32.28'	3+83.76	5.18L
B-18	Sagewillow Dr.	13782301.31	3168992.79	31.90'	10+44.05	4.94L
B-19	Sagewillow Dr.	13782467.05	3168806.33	32.53'	7+94.58	5.24L
B-20	Sagewind Dr.	13782723.45	3168939.73	32.51'	7+24.45	5.58L
B-21	Sagewind Dr.	13782900.30	3168745.77	32.33'	4+61.72	5.44L
B-22	Sagedown Ln.	13782498.65	3169194.00	32.04'	10+63.85	6.09L
B-23	Sagepark Ln.	13782795.72	3169277.12	32.26'	9+29.51	3.28L
B-24	Sagedown Ln.	13782671.61	3169528.35	31.60'	15+65.35	3.76R
B-25	Sagevalley Dr.	13783140.99	3169312.64	32.19'	7+07.30	5.37L
B-26	Sagevalley Dr.	13783329.51	3169108.35	31.08'	4+28.98	6.15L
B-27	Sagecanyon Dr.	13782847.41	3165687.46	35.67'	6+24.95	3.51L
B-28	Sagecanyon Dr	13782584.48	3165987.58	35.08'	10+23.95	5.54L
B-29	Sagecanyon Dr	13782291.50	3166316.47	34.15'	14+64.41	4.16L
B-30	Sagecanyon Dr	13782007.25	3166633.56	34.20'	18+89.78	3.57L

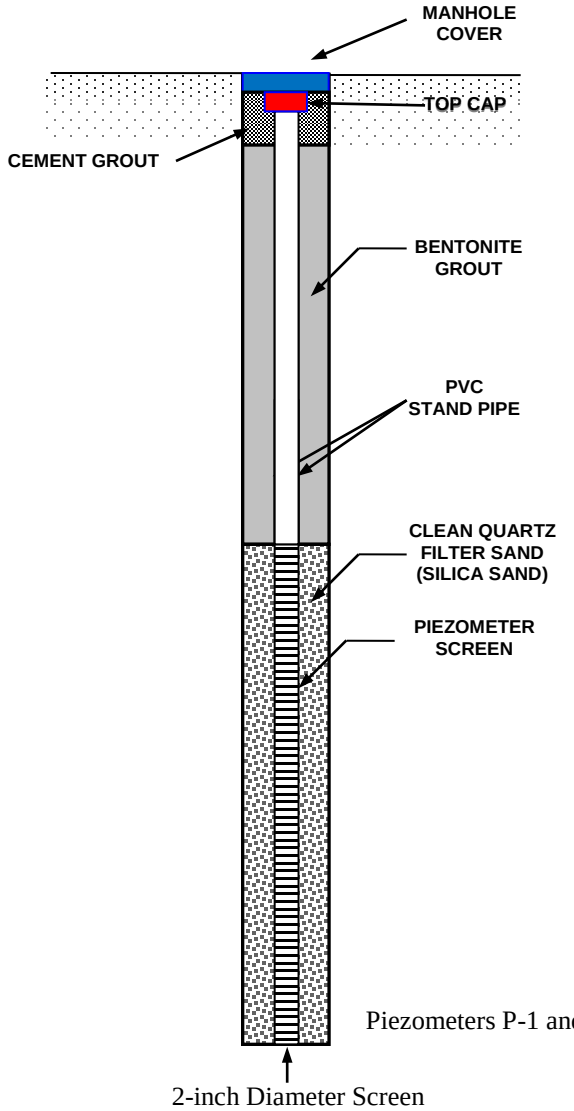
Boring No.	Alignment	Northing	Easting	Elevation	Station No.	Offset (ft.)
B-31	Sagebluff Dr.	13782894.83	3166343.75	34.00'	12+59.94	6.56L
B-32	Sagebluff Dr.	13783004.35	3165936.70	35.39'	7+05.59	6.21L
B-33	Sagebluff Dr.	13783229.65	3165681.60	34.43'	3+65.25	5.83L
B-34	Sagetrail Dr.	13783393.77	3165919.96	34.57'	4+33.00	6.74L
B-35	Sagetrail Dr.	13783166.89	3166173.55	35.15'	7+73.21	5.10L
B-36	Sagetrail Dr.	13782510.24	3166747.35	35.27'	16+46.15	4.73L
B-37	Sagetrail Dr.	13782235.76	3166951.71	34.04'	19+88.63	5.42L
B-38	Sagebarrow Dr.	13782685.27	3166967.65	34.02'	16+68.04	5.72L
B-39	Sageorchard Dr.	13783040.15	3166861.56	33.00'	10+76.02	5.49R
B-40	Sageburrow Dr.	13783288.55	3166454.30	34.00'	8+75.66	5.52L
B-41	Sageburrow Dr.	13783594.96	3166113.11	33.34'	4+17.27	5.41L
B-42	Sageburrow Dr.	13783745.36	3165946.28	32.79'	1+92.67	7.45L
B-43	Sageberry Dr.	13784016.97	3166209.03	31.92'	2+31.78	5.39L
B-44	Sageberry Dr.	13783661.67	3166610.29	33.60'	7+67.70	5.25L
B-45	Sageberry Dr.	13783490.48	3166791.14	32.66'	10+16.43	5.96L
B-46	Sageorchard Dr.	13783144.10	3166955.15	32.79'	12+15.90	6.70R
B-47	Sageberry Dr.	13782874.66	3167253.98	33.51'	17+88.63	31.25R
B-48	Sagevale Ln.	13783175.82	3167425.30	33.07'	17+04.49	3.67L
B-49	Sageorchard Dr.	13783484.63	3167254.00	32.26'	16+68.96	4.74R
B-50	Sagevale Ln.	13783695.47	3166981.86	33.37'	10+21.43	5.73L
B-51	Sagevale Ln.	13784177.93	3166450.88	33.13'	3+04.23	6.19L
B-3A	Sagecanyon Dr	13780830.88	3167990.01	33.05'	16+94.02	9.96L
B-4A	Sagecanyon Dr	13780782.80	3168044.24	32.79'	17+66.68	9.82L
B-46A	Sageorchard Dr.	13783080.98	3166919.36	33.00'	11+59.02	9.18R

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: Water Line Replacement in Hughes Road Area in the City of Houston, Texas
(WBS No. S-000035-0187-4)
PROJECT No.: 14-320E
GEOTECHNICAL CONSULTANT: Geotech Engineering and Testing
DESIGN CONSULTANT: Quadrant Consultants, Inc.

Piezometer No.	Boring No.	Piezometer Tip		Depth to Filter Sand, ft.		Bentonite Grout, ft		Cement Grout, ft	
		Depth, ft.	Screen Length, ft.	Top	Bottom	Top	Bottom	Top	Bottom
PZ-1	B-29	16.00	12.00	4.00	16.00	2.00	4.00	0.00	2.00
PZ-2	B-43	16.00	12.00	4.00	16.00	2.00	4.00	0.00	2.00

Notes: (1) Depth is referenced from existing ground surface.



Note: Drawing is not to scale.

Piezometers P-1 and P-2

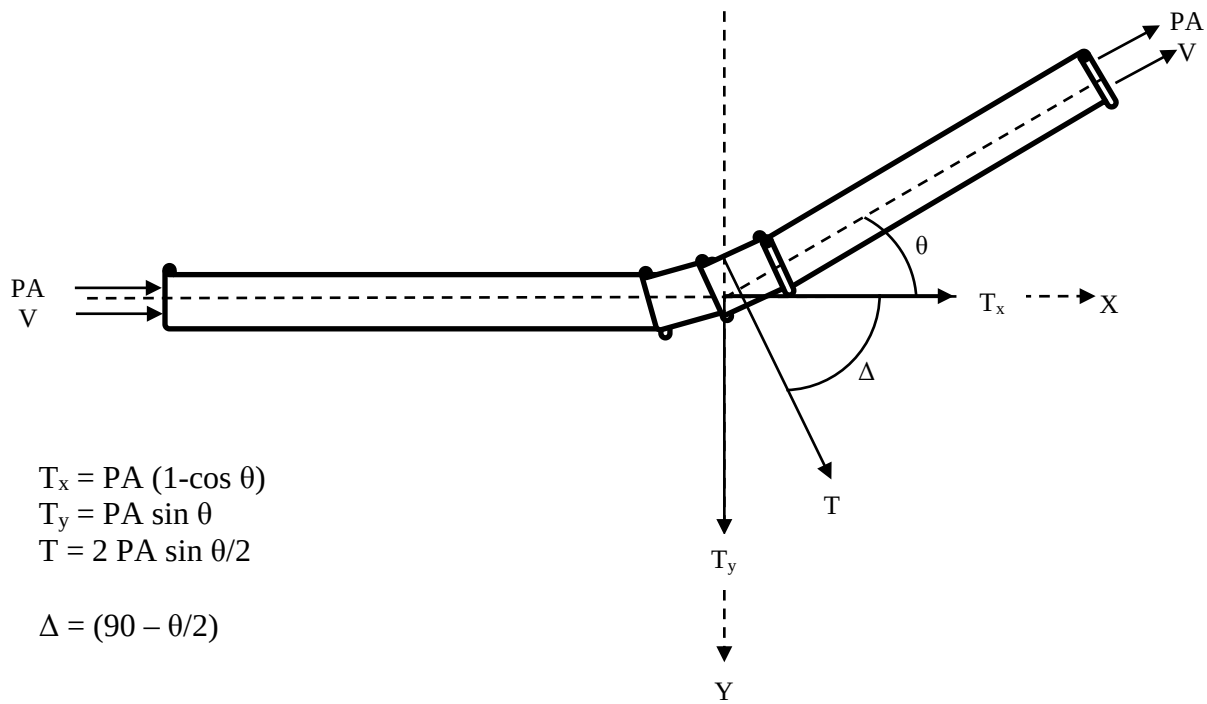
Piezometer No.	Station No.	Northing	Easting	Elevation (ft)
PZ-1	14+64.41	13782291.50	3166316.47	34.15
PZ-2	2+31.78	13784016.97	3166209.03	31.92

PIEZOMETER READING TABLE

Piezometer No.	Piezometer Groundwater Depths During Drilling from Ground Surface	Groundwater Level in Piezometer					
		July 25, 2014			August 12, 2014		
		Before Bailing	After Bailing		Before Bailing	After Bailing	
PZ-1 (16')	Dry	14′0"	Time (Min.)	Groundwater Depth (ft)	13′0"	Time, (Min.)	Groundwater Depth (ft)
			1	15.3		1	14.8
			2	15.1		2	14.7
			5	14.9		5	14.5
			10	14.8		10	14.1
			20	14.6		20	14.0
			30	14.4		30	13.8
			60	14.2		60	13.5
PZ-2 (16')	Dry	13′0"	Time (Min.)	Groundwater Depth (ft)	12′6"	Time, (Min.)	Groundwater Depth (ft)
			1	14.9		1	14.1
			2	14.7		2	13.9
			5	14.6		5	13.8
			10	14.2		10	13.6
			20	14.1		20	13.4
			30	14.0		30	13.2
			60	13.8		60	13.0

Note: Borings B-29 and B-43were converted to Piezometers PZ-1 and PZ-2, respectively. The piezometer depth is shown in parenthesis.

THRUST FORCES ACTING ON BEND



$T_x = PA\ (1\text{-}\cos\theta)$
$T_y = PA \sin\theta$
$T = 2\ PA \sin\theta/2$

$\Delta = (90 - \theta/2)$

Where:

T = Resultant Thrust Force on the Bend
T_x = Component of Thrust Force in X-Direction
T_y = Component of Thrust Force in Y-Direction
P = Maximum Sustained Pressure
A = Pipe Cross Sectional Area
θ = Bend Deflection Angle
V = Fluid Velocity

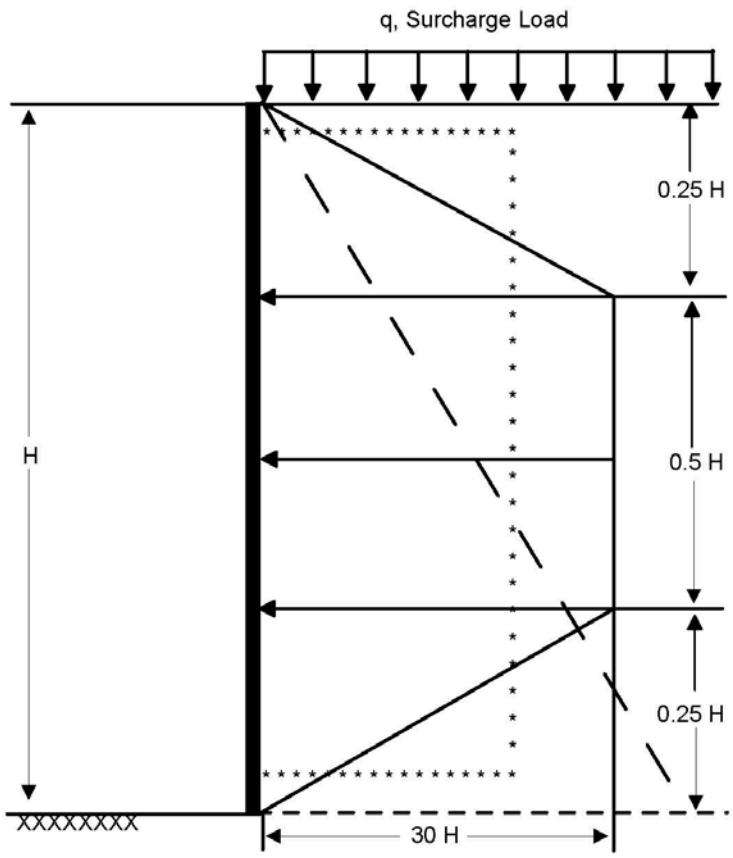
Δ = Angle between T and X-axis
D = Inside Diameter of the Pipe

Sample Calculation:

Given P = 50 psi, D = 12-inch
$A = \pi d^2/4 = 113.1\ in^2$

For θ = 90°
$T = 2\ PA \sin\theta/2 = 2 * 50 * 113.1 * \sin(90/2) = 7997.4$ lb = 7.99 kips
$Tx = PA\ (1 - \cos\theta) = 50 * 113.1 * (1 - \cos 90°) = 5.66$ kips
$Ty = PA \sin\theta = 50 * 113.1 * \sin 90° = 5.66$ kips

LATERAL EARTH PRESSURE DIAGRAM



Legend:

——————— Braced Excavation (stiff clays)
* * * * * * * * * * * * * Braced Excavation (sands)
- - - - - - - - - - - - - - Cantilevered sheeting

Active Pressure:

(a) Braced Excavation (stiff clays) = 0.5q + 30H + 62.4H
(b) Braced Excavation (sands) = 0.4q + 18H + 62.4H
(c) Cantilevered sheeting = 0.7q + 42H + 62.4H

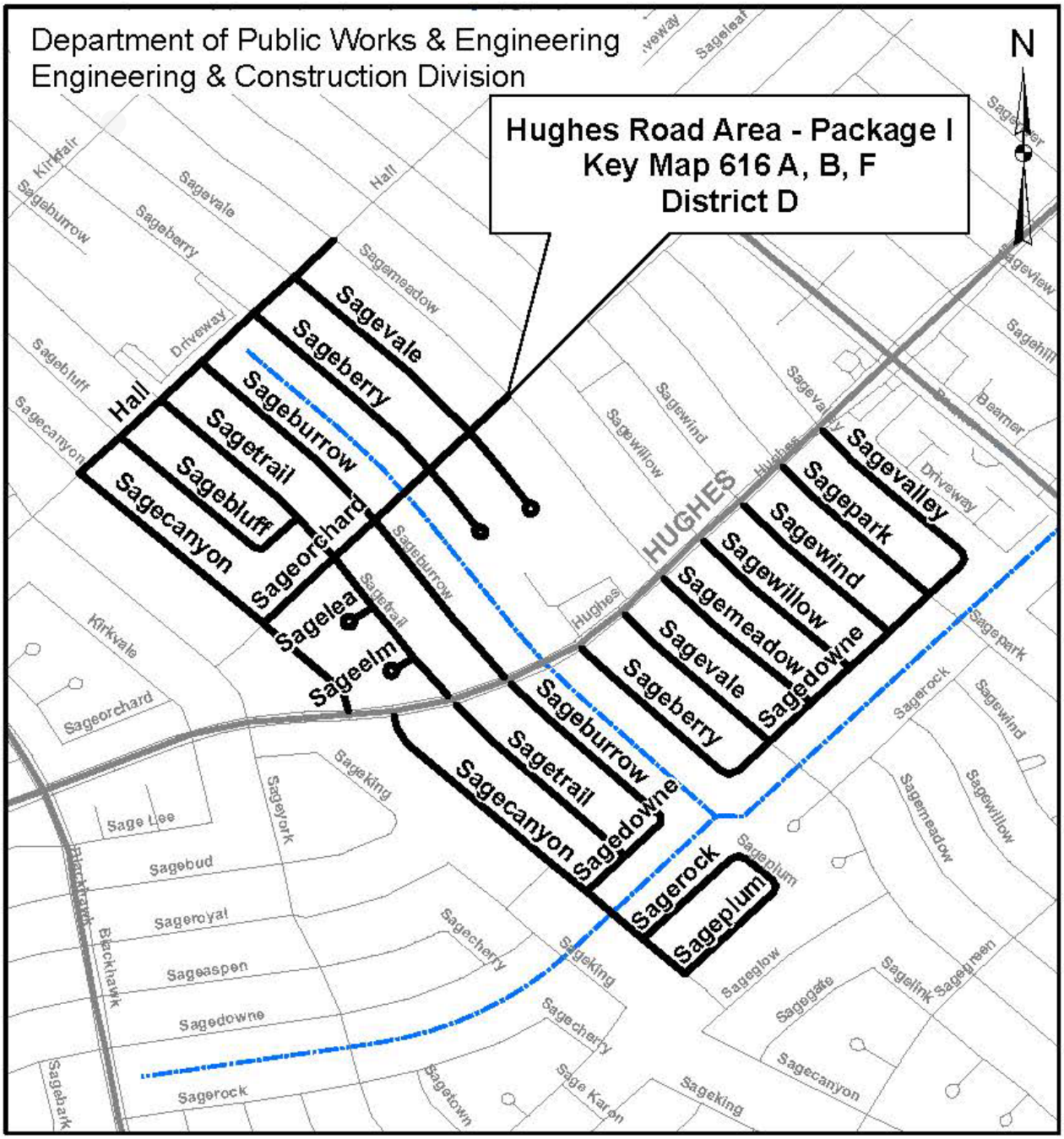
where: q = surcharge load, psf: A value of 250 psf can be assumed.
H = wall height, ft.

Notes:

1. The above Active Pressure Equations account for the groundwater at the surface.
2. The final lateral pressures should be reviewed prior to construction.
3. Trench excavation and construction should be observed by a geotechnical engineer.
4. The means and methods for a safe excavation is the responsibility of the contractor.
5. In case of layered soils, active pressure should be calculated based on the dominant or more critical soil conditions.

APPENDIX A

Site Vicinity Map
Plan of Borings
Soil Stratigraphy Profiles
Log of Borings
Key to Log Terms and Symbols
Summary of the Laboratory Test Results

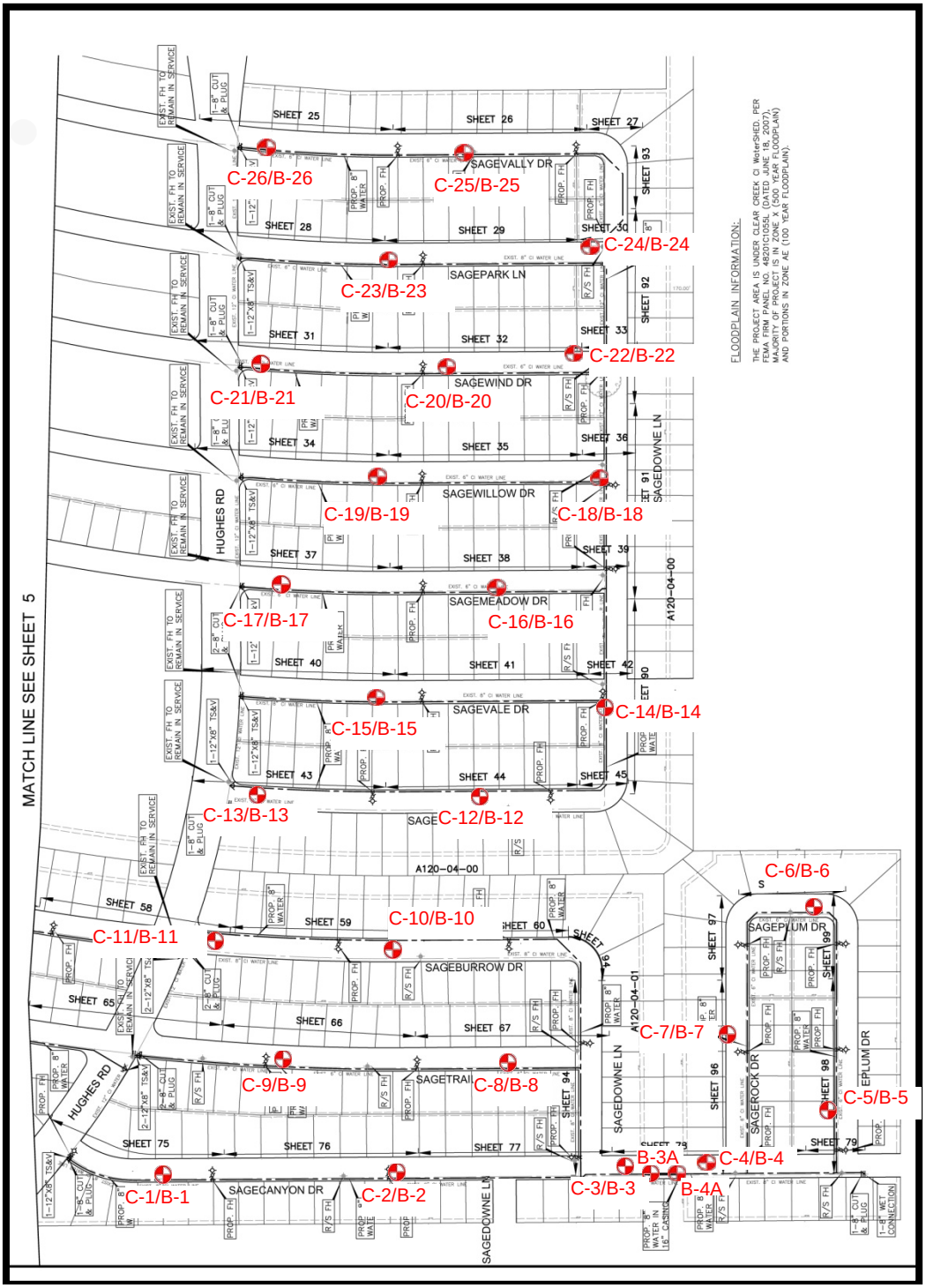


SITE VICINITY MAP

PROJECT: Geotechnical Study, Proposed Water Lines Replacement in Hughes Road Area
WBS No. S-000035-0187-4, City of Houston, Texas

SCALE: 1"=600'	DATE: NOVEMBER 2015	PROJECT NO.: 14-320E

NORTH



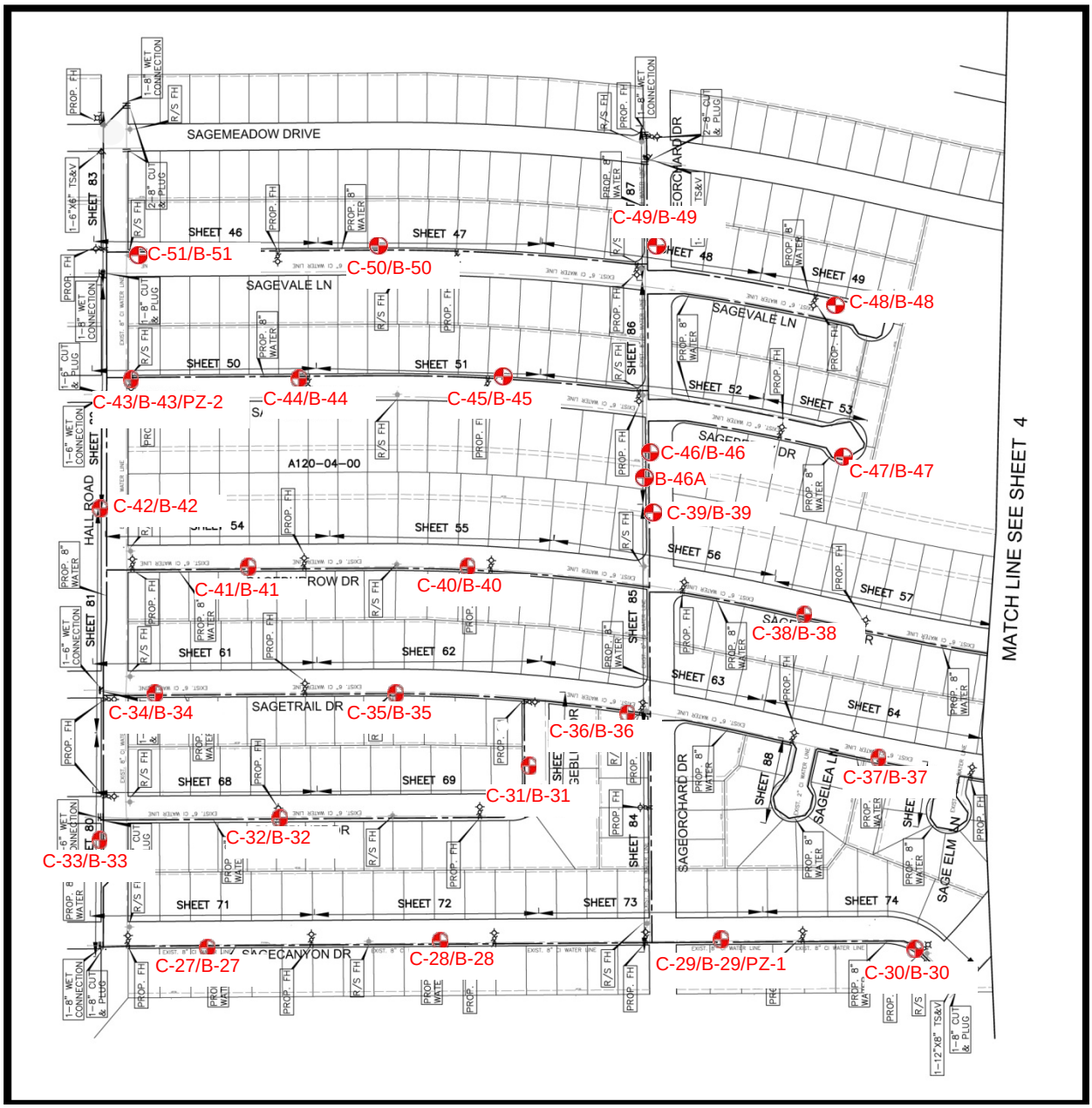
Legend:
C-1: Coring C-1
B-1: Boring B-1

PLAN OF BORINGS (borings dimensions and locations are approximate)

NORTH

PROJECT: Geotechnical Study, Proposed Water Line Replacement in Hughes Road Area
WBS No. S-000035-0187-4, City of Houston, Texas

SCALE: 1" = 120'	DATE: NOVEMBER 2015	PROJECT NO.: 14-320E



Legend:

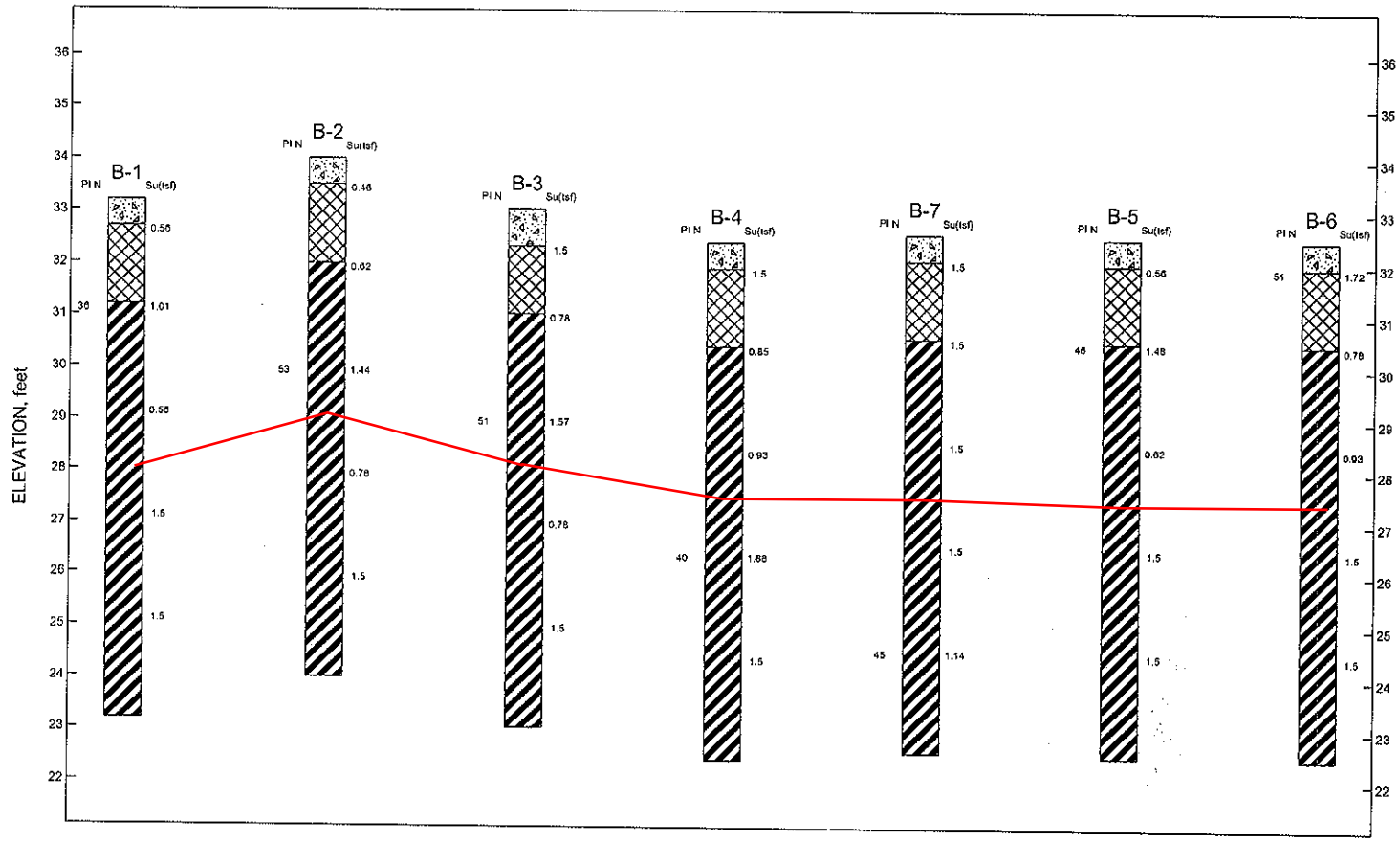
C-27: Coring C-27
B-27: Boring B-27
PZ-1: Piezometer PZ-1

PLAN OF BORINGS (borings dimensions and locations are approximate)

NORTH

PROJECT: Geotechnical Study, Proposed Water Line Replacement in Hughes Road Area
WBS No. S-000035-0187-4, City of Houston, Texas

SCALE: 1" = 120'	DATE: NOVEMBER 2015	PROJECT NO.: 14-320E

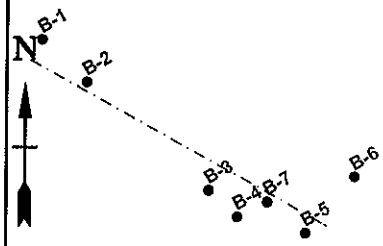


Lithology Graphics

Concrete

Fill

Fat Clay (CH)



Site Map Scale 1 inch equals 1,130 feet

Explanation

B-1 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022

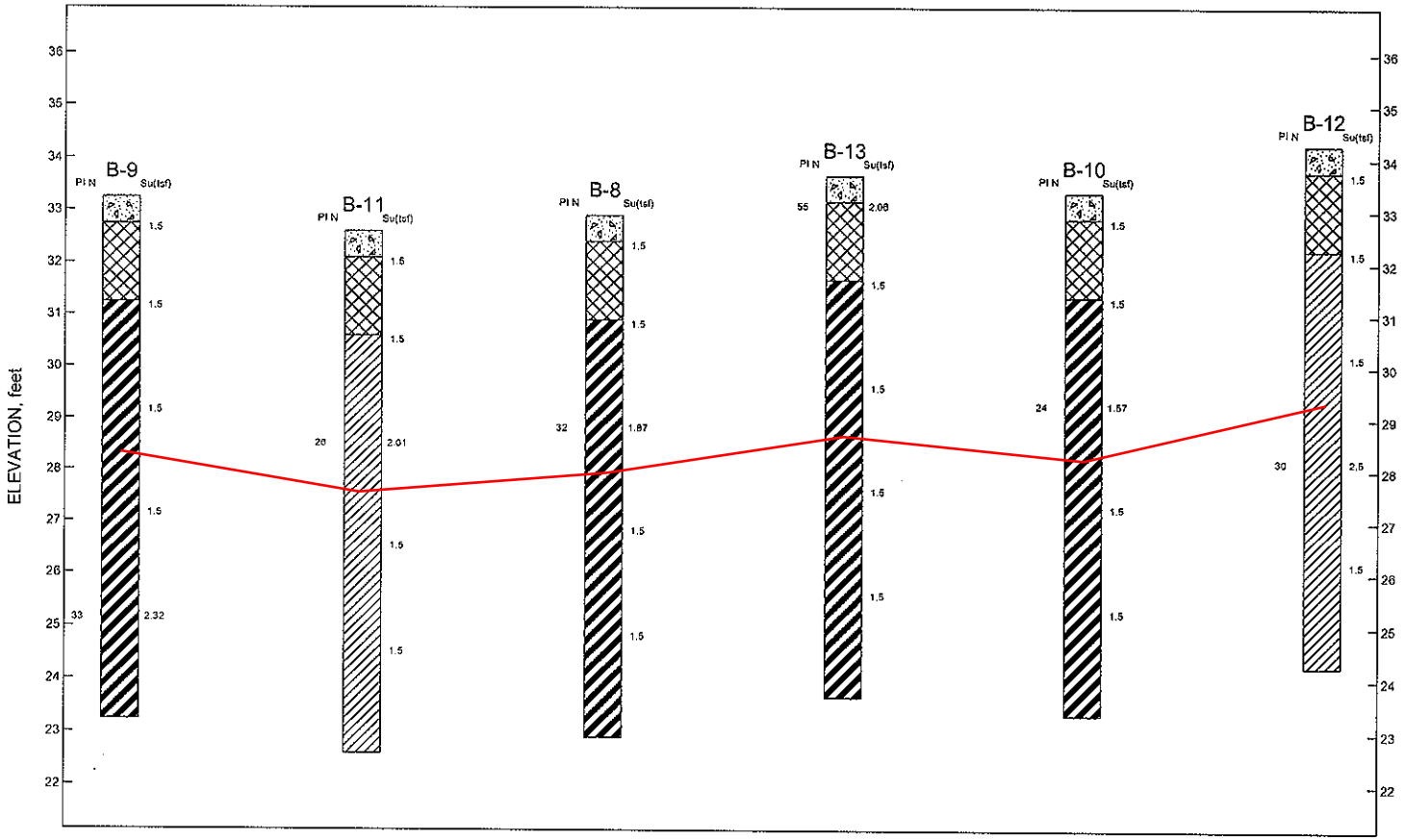
Proposed Water Lines Replacement at Hughes Road Area

GEOTECH ENGINEERING & TESTING

City of Houston
Texas

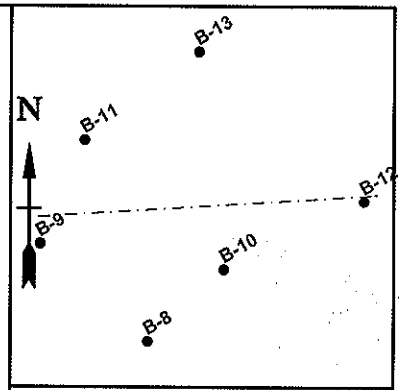
JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-4

BERNARD 14-320E.GPJ FANWNL01.GDT 10/28/14



Lithology Graphics

- Concrete
- Fill
- Fat Clay (CH)
- Lean Clay (CL)



Site Map Scale 1 inch equals 510 feet

Explanation

B-9 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022

Proposed Water Lines Replacement at Hughes Road Area

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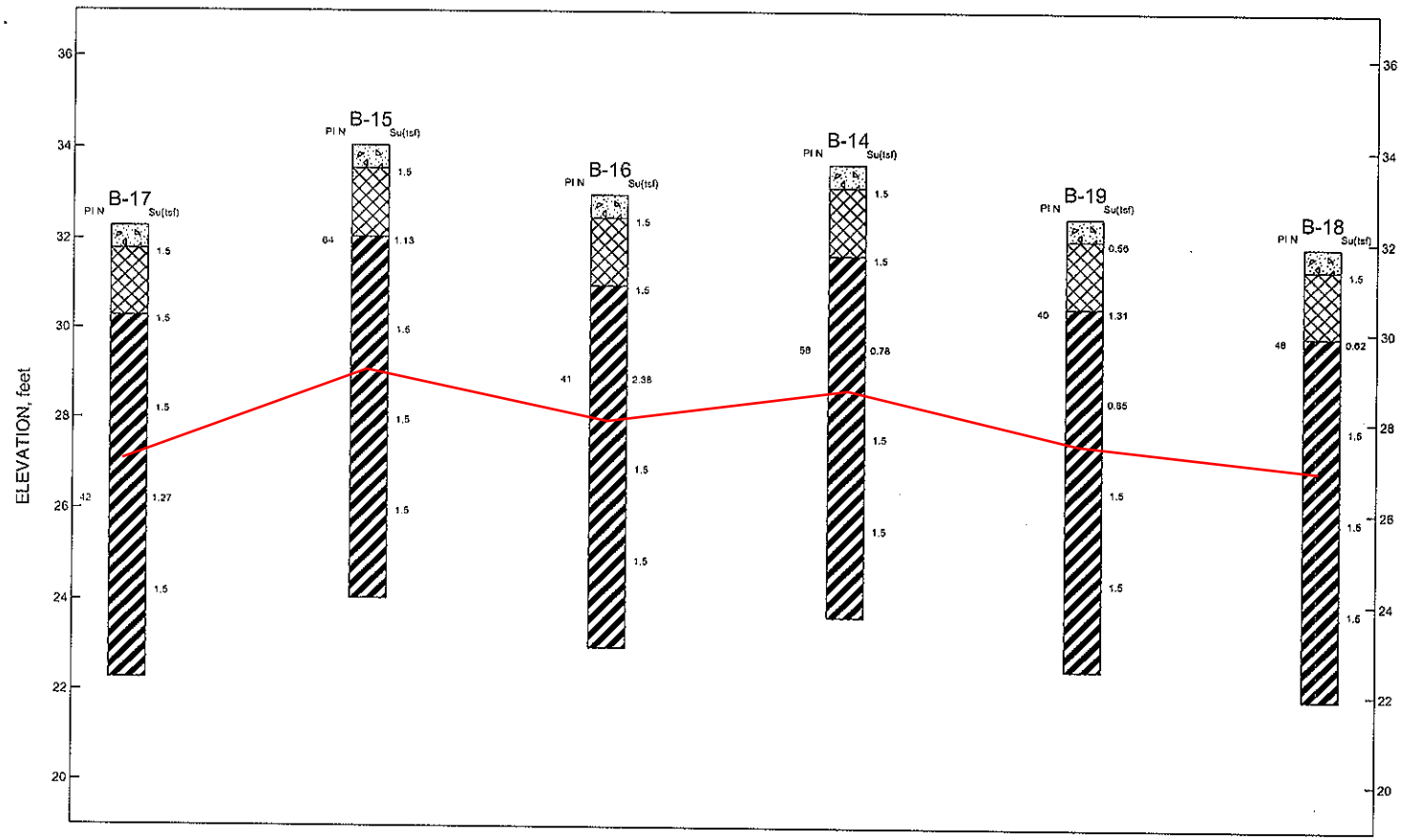
City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-5

BERNARD 14-320E.GPJ FANWNL01.GDT 10/28/14

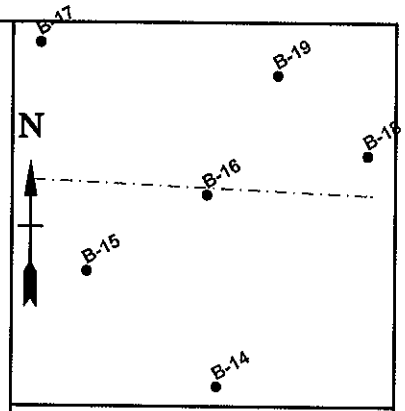


Lithology Graphics

Concrete

Fill

Fat Clay (CH)



Site Map Scale 1 inch equals 395 feet

Explanation

B-17 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022

Proposed Water Lines Replacement at Hughes Road Area

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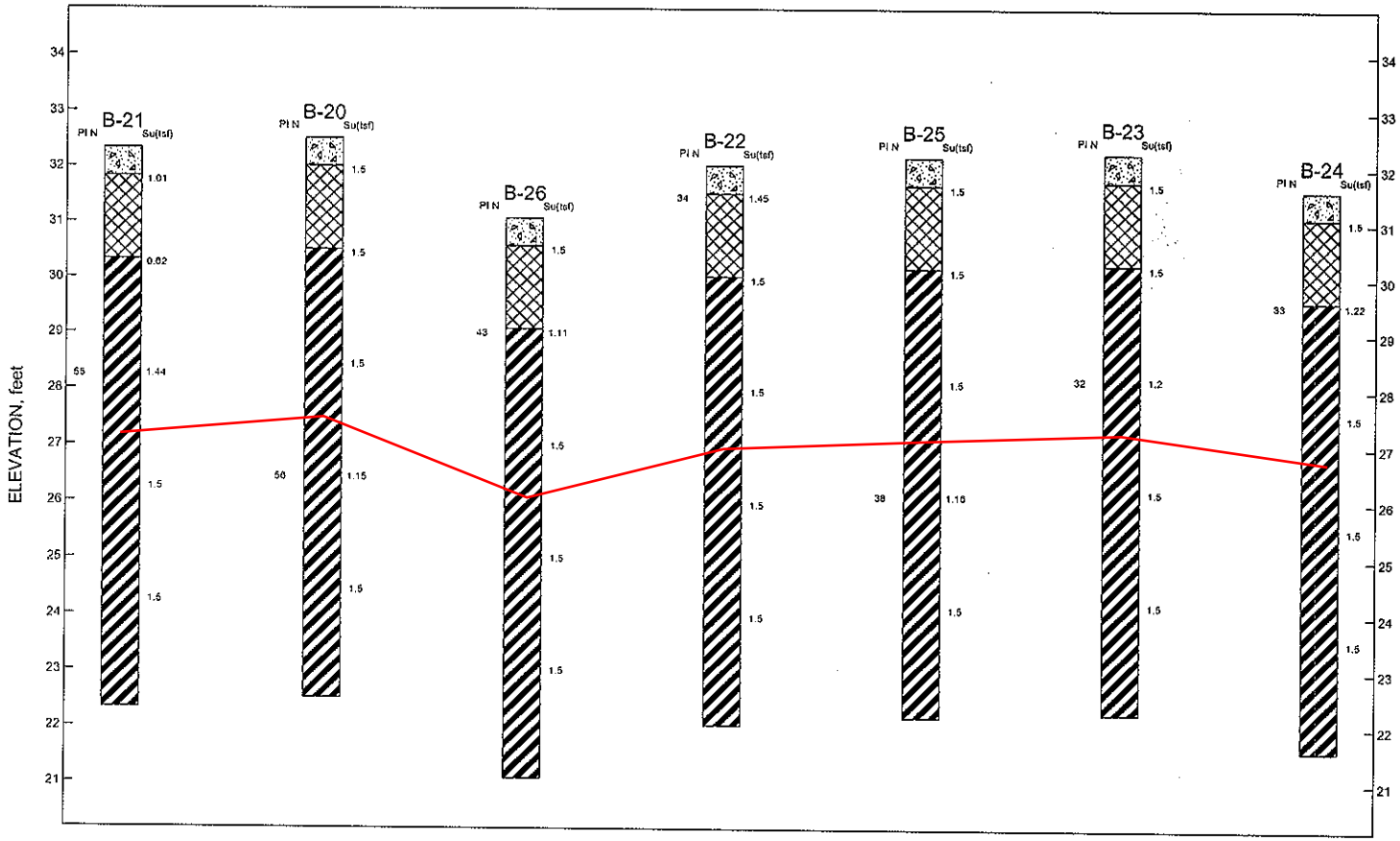
City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-6

BERNARD 14-320E.GPJ FANWNL01.GDT 10/28/14

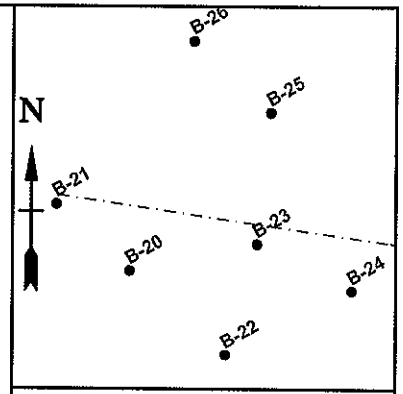


Lithology Graphics

Concrete

Fill

Fat Clay (CH)



Site Map Scale 1 inch equals 510 feet

Explanation

B-21 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022

Proposed Water Lines Replacement at Hughes Road Area

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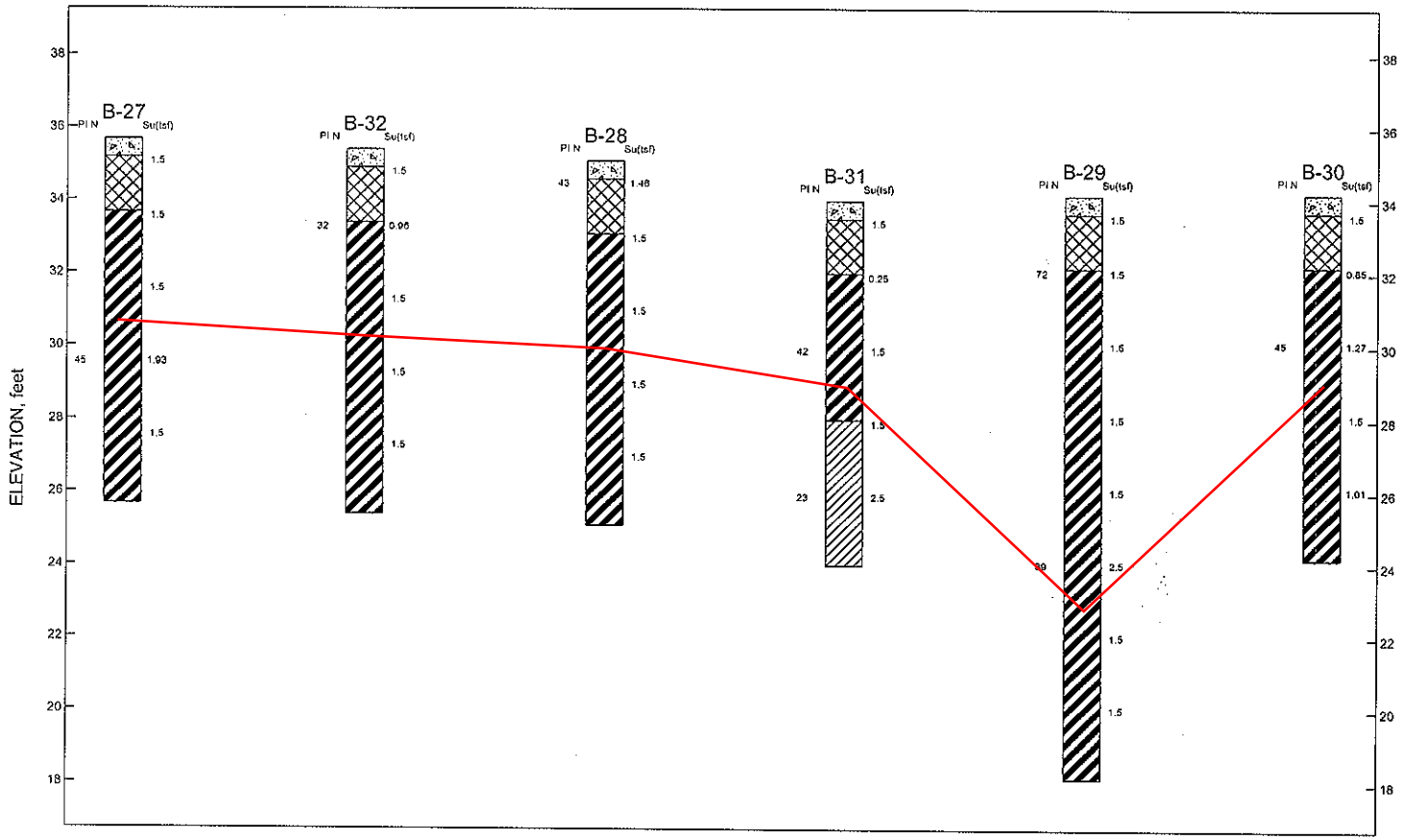
City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000036-0187-4	PLATE A-7

BERNARD 14-320E.GPJ FANWNL01.GDT 10/28/14



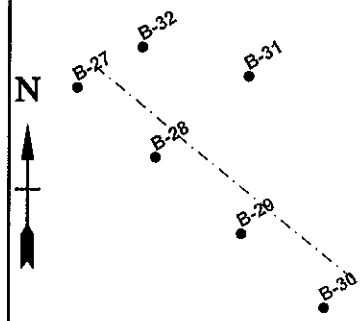
Lithology Graphics

Concrete

Fill

Fat Clay (CH)

Lean Clay (CL)



Site Map Scale 1 inch equals 735 feet

Explanation

B-27 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77040

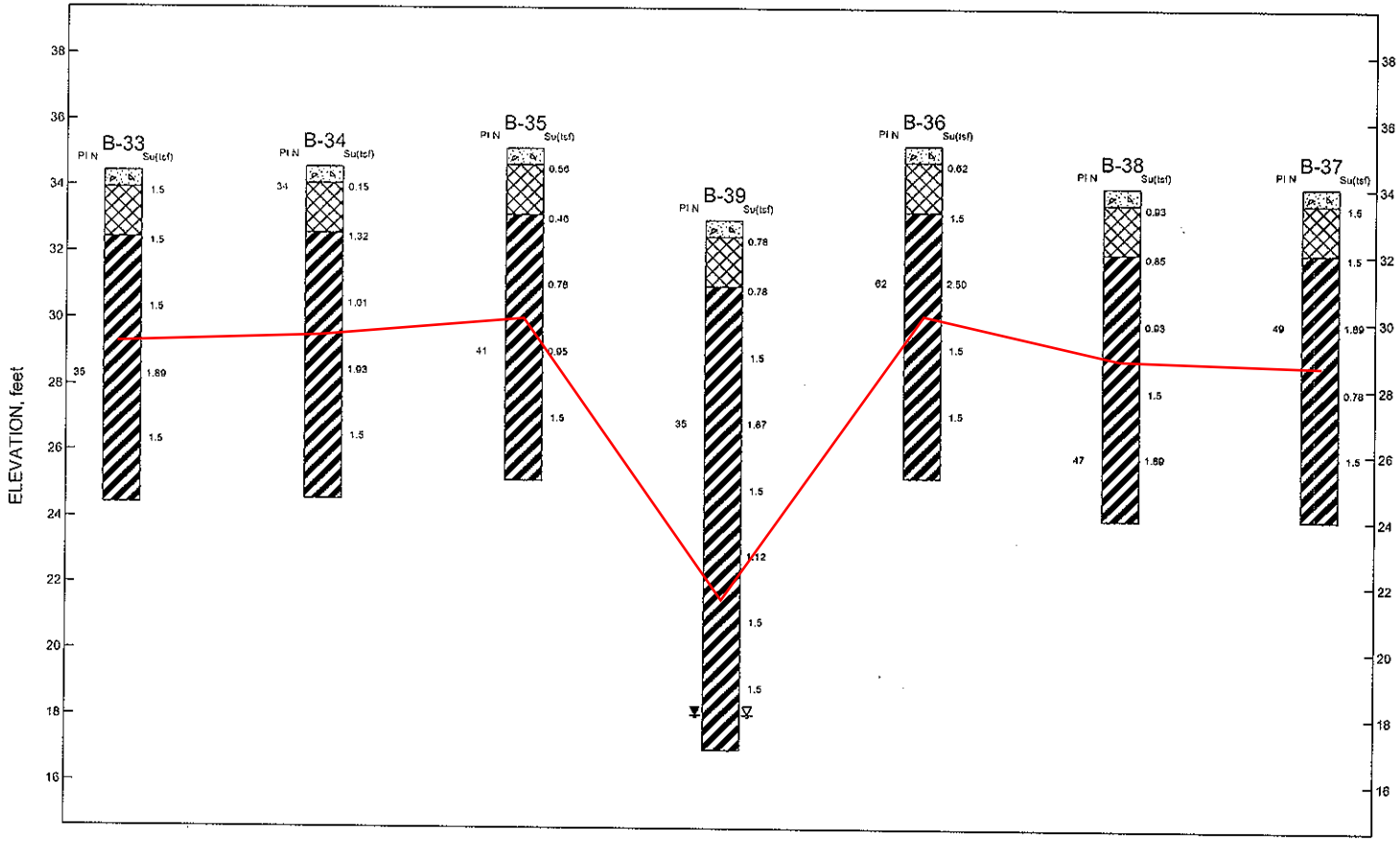
Proposed Water Lines Replacement at Hughes Road Area

GEOTECH ENGINEERING & TESTING

City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-8

BERNARD 14-320E.GPJ FANWNL01.GDT 8/22/14

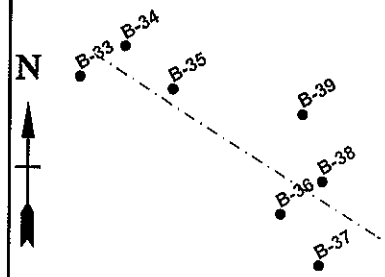


Lithology Graphics

Concrete

Fill: Fat Clay (CH)

Fat Clay (CH)



Site Map Scale 1 inch equals 1,015 feet

Explanation

B-33 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77040

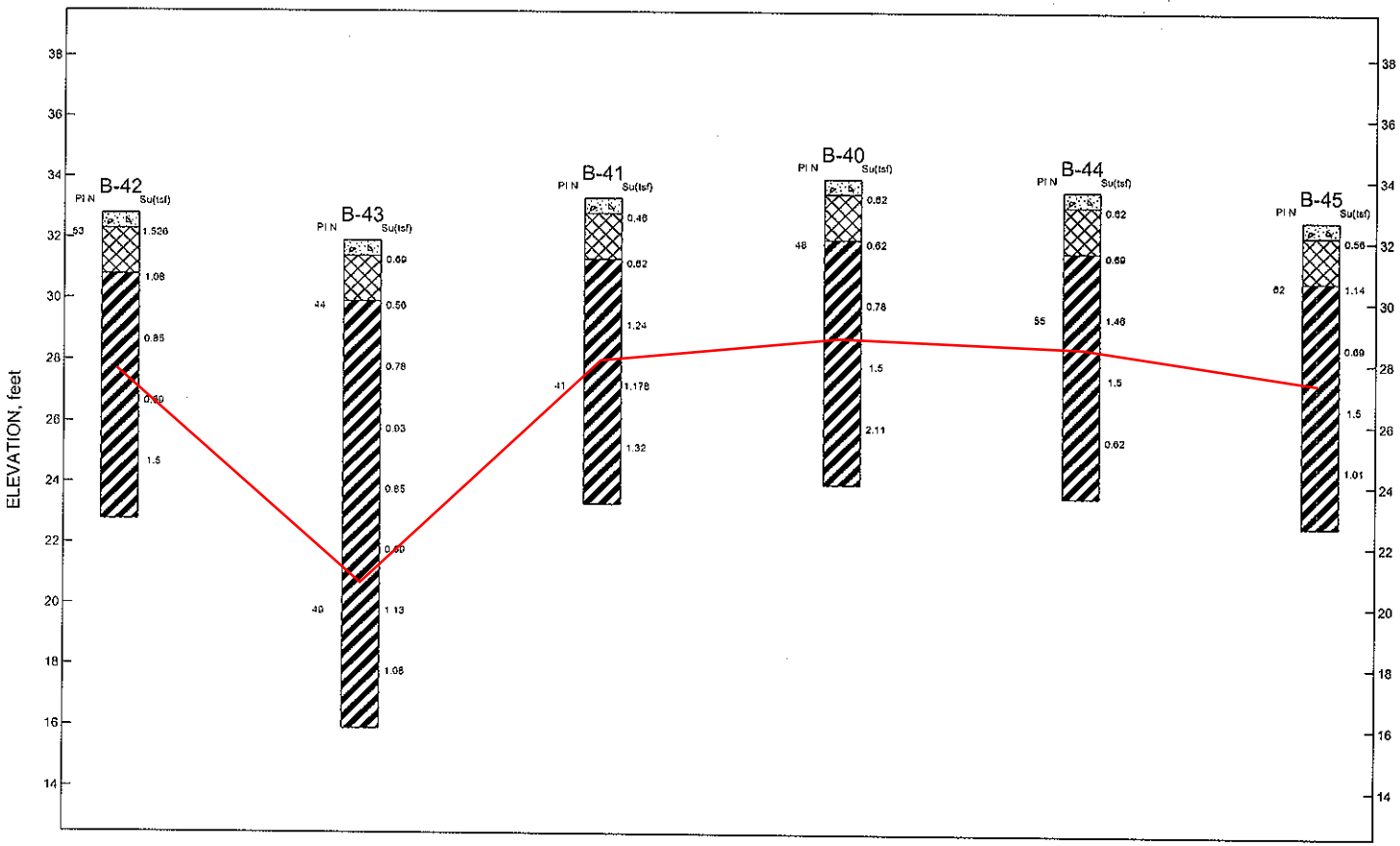
Proposed Water Lines Replacement at Hughes Road Area

GEOTECH ENGINEERING & TESTING

City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-9

BERNARD 14-320E.GPJ FANWNL01.GDT 8/22/14

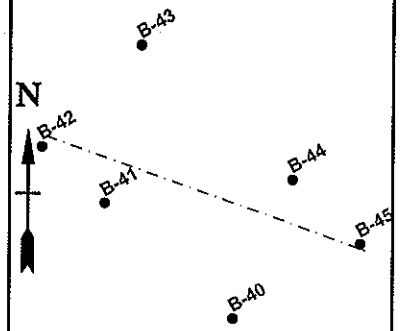


Lithology Graphics

Concrete

Fill: Fat Clay (CH)

Fat Clay (CH)



Site Map Scale 1 inch equals 510 feet

Explanation

B-42 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77040

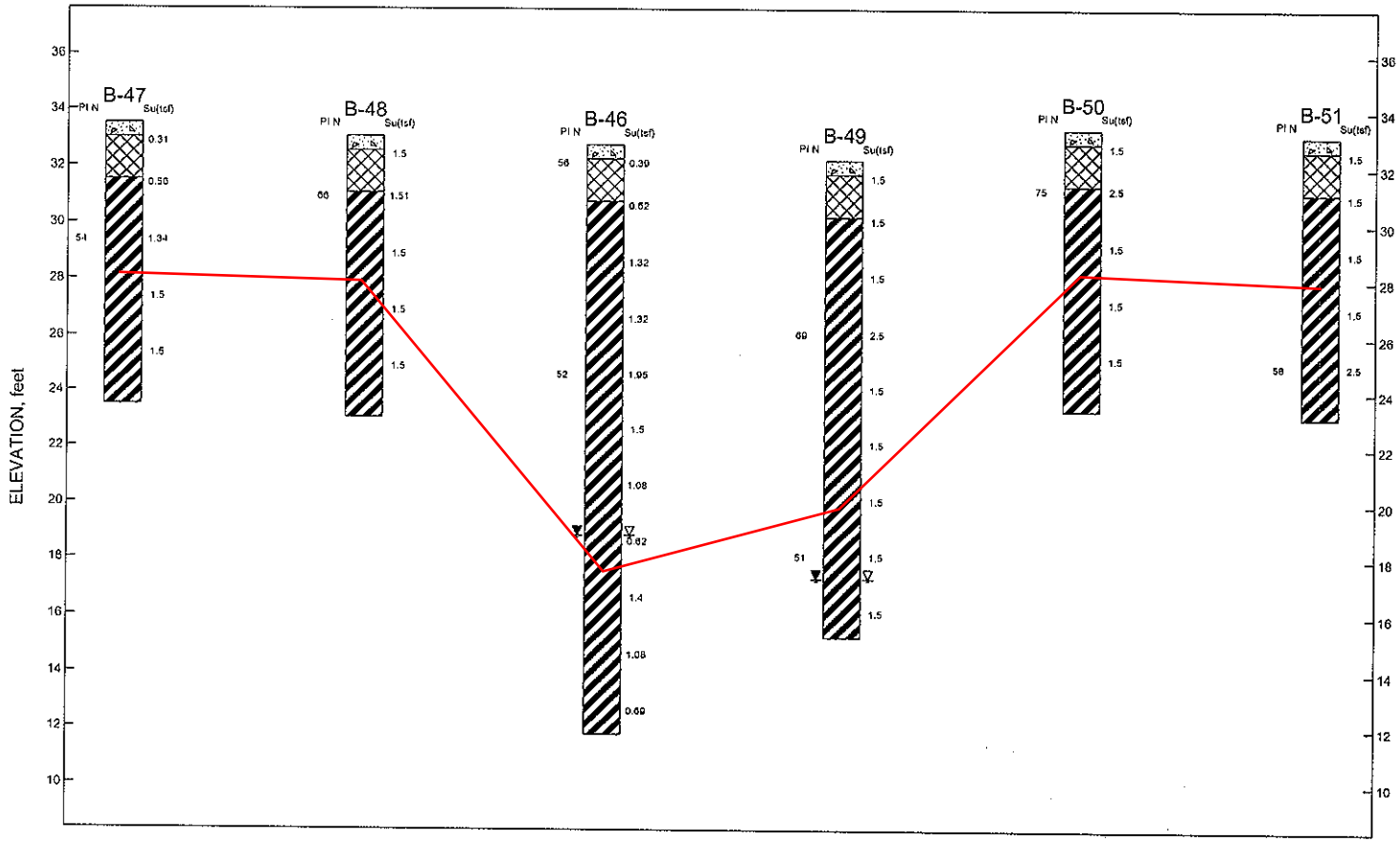
Proposed Water Lines Replacement at Hughes Road Area

GET GEOTECH ENGINEERING & TESTING

City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-10

BERNARD 14-320E.GPJ FANWNL01.GDT 8/22/14

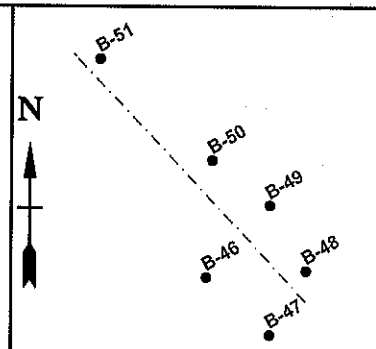


Lithology Graphics

Concrete

Fill: Fat Clay (CH)

Fat Clay (CH)



Site Map Scale 1 inch equals 905 feet

Explanation

B-47 — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77040

Proposed Water Lines Replacement at Hughes Road Area

City of Houston
Texas

JOB NUMBER	PLATE NUMBER
S-000035-0187-4	PLATE A-11

BERNARD 14-320E.GPJ FANWNL01.GDT 8/22/14

LOG OF BORING NO. B-1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 2+84.37
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13781760.63
EASTING: 3166936.51
ELEVATION: 33.19'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	31							
					FAT CLAY (CH), very stiff, light brown, light gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	30	59	23	36	92	101		
					- stiff 4' to 6'								
5						32							
						21							
					- reddish brown 8' to 10'	27							
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 10/28/14

LOG OF BORING NO. B-2

Sheet 1 of 1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 6+52.52
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13781510.61
EASTING: 3167202.77
ELEVATION: 34.00'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), firm, light gray, dark gray, with root fibers, ferrous and calcareous nodules, moist	30								
					FAT CLAY (CH), stiff, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	31								
					- very stiff 4' to 6'									
5						33	76	23	53	92		106		
						33								
					- very stiff 8' to 10'									
						21								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-3

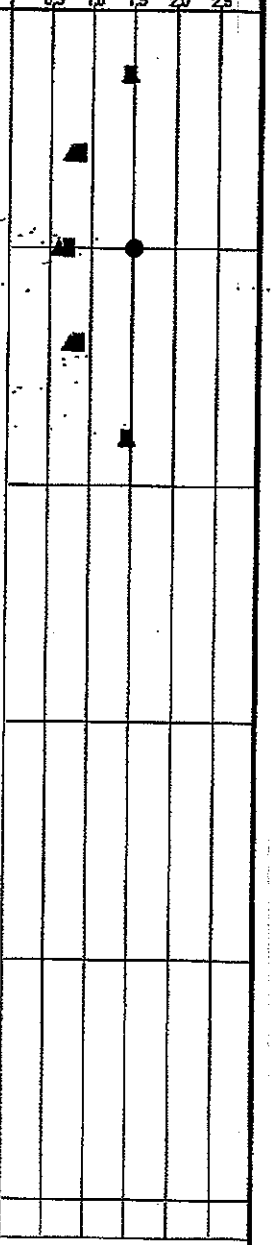
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 16+14.08
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780872.96
EASTING: 3167922.50
ELEVATION: 33.04'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (9.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	29								
					FAT CLAY (CH), stiff, light gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	30								
					- very stiff 4' to 6'									
5						29	73	22	51	87		102		
						27								
					- very stiff 8' to 10'	30								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-4

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 18+42.61
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780719.89
EASTING: 3168092.20
ELEVATION: 32.43'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, light gray, dark gray, with root fibers, ferrous and calcareous nodules	26								
					FAT CLAY (CH), stiff, light brown, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	33								
5						30								
					- very stiff 6' to 10'	26	51	21	40	88		97		
					- reddish brown 8' to 10'	22								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-5

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+28.91
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780628.19
EASTING: 3168493.84
ELEVATION: 32.52'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, light gray, dark gray, with root fibers, ferrous and calcareous nodules, moist	30								
					FAT CLAY (CH), very stiff, light brown, light gray, with root fibers to 6', ferrous and calcareous nodules, moist	26	68	22	46	99		100		
					- stiff 4' to 6'									
5						26								
						33								
						29								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL

0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-328E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-6

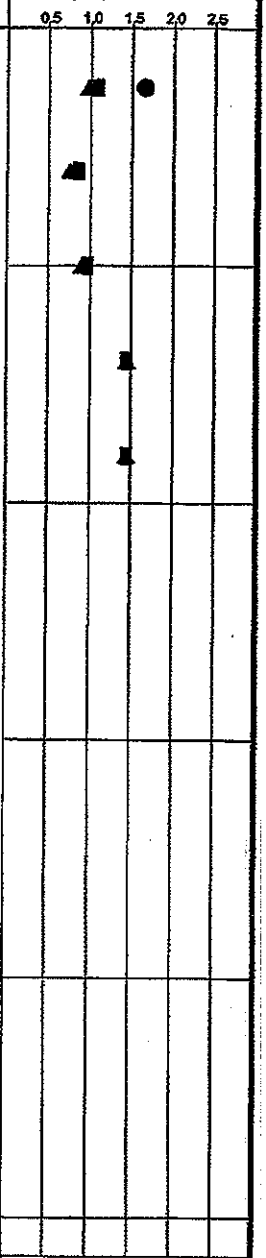
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 . STATION NO.: 7+67.77
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780963.61
EASTING: 3168780.34
ELEVATION: 32.48'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	27	74	23	51			97		
					FAT CLAY (CH), stiff, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	33								
5						31								
					- very stiff 6' to 10'	33								
					- reddish brown 8' to 10'	23								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-820E.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-7

Sheet 1 of 1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+12.06
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780808.67
EASTING: 3168267.63
ELEVATION: 32.59'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	15								
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules, moist	8								
5						15								
					- reddish brown 6' to 10'	15								
						12	66	21	45			109		
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-8

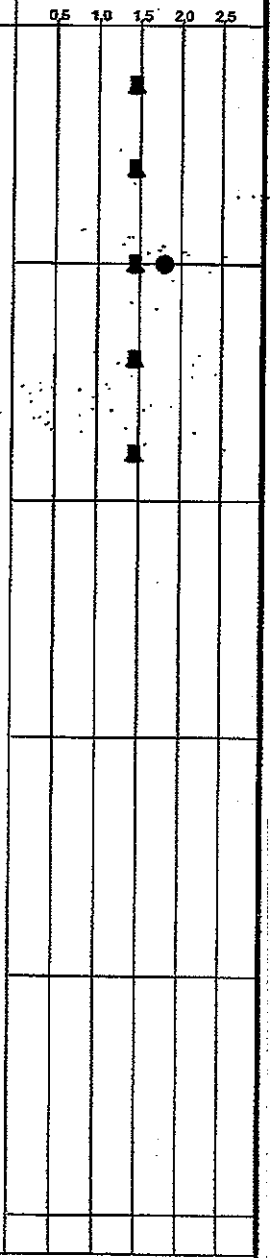
Geotech Engineering and Testing
880 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 32+19.69
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13781351.06
EASTING: 3167803.45
ELEVATION: 32.91'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	24								
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules	13								
5						11	51	19	32	88		108		
						16								
					- reddish brown 8' to 10'	12								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-9

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 28+33.89
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13781610.33
EASTING: 3167518.11
ELEVATION: 33.24'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ■ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	16									
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules	12									
5						13									
					- reddish brown 6' to 10'	10									
					- hard 8' to 10'	17	52	19	33	86		104			
10															
15															
20															
25															

UNDRAINED SHEAR STRENGTH, tsf: 0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-10

Sheet 1 of 1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 32+16.29
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORHTING:13781543.29
EASTING:3168005.13
ELEVATION: 33.35'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	15							
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules, moist	19							
5						14	52	19	33		109		
					- reddish brown 8' to 10'	13							
						17							
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-11

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 27+11.81
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORHTING:13781886.06
EASTING: 3167635.46
ELEVATION: 32.60'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: LEAN CLAY (CL), very stiff, dark gray, with root fibers, ferrous nodules	16							
					LEAN CLAY (CL), very stiff, light gray, gray, with root fibers to 6', ferrous nodules, moist	14							
					- hard 4' to 6'								
5						13	44	18	26	86	109		
					- reddish brown 6' to 10'	16							
						16							
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-12

Sheet 1 of 1

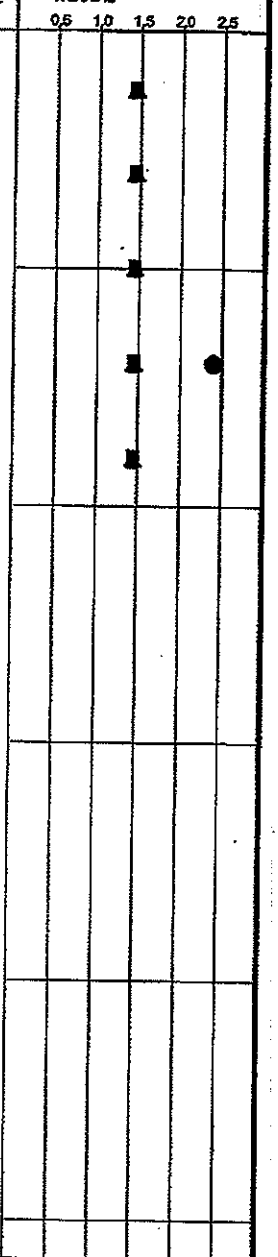
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 9+70.92
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING:13781725.10
EASTING:3168376.22
ELEVATION: 34.26

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: LEAN CLAY WITH SAND (CL), very stiff, dark gray, with root fibers, ferrous nodules	13								
					LEAN CLAY (CL), very stiff, dark gray, with root fibers to 6', ferrous nodules, sands	13								
5						17								
					- hard 6' to 8'	16	48	18	30	89		106		
					- reddish brown 8' to 10'	14								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-13

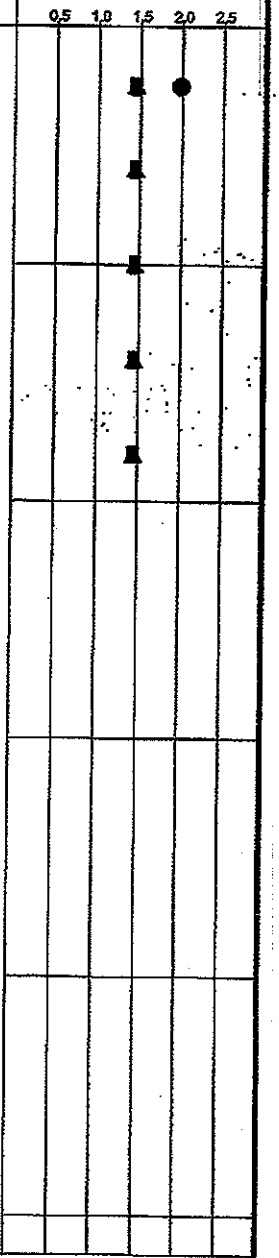
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+77.15
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782124.53
EASTING: 3167937.36
ELEVATION: 33.68'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), hard, light gray, dark gray, with root fibers, ferrous and calcareous nodules	13	78	23	55	96		106		
					FAT CLAY (CH), very stiff, gray, with root fibers to 6', ferrous and calcareous nodules	15								
5						18								
						15								
					- reddish brown 8' to 10'	15								
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-14

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 11+33.61
DATE: 7-7-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13781827.14
EASTING: 3168683.68
ELEVATION: 33.68'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, gray, dark gray, with root fibers, ferrous and calcareous nodules	18								
					FAT CLAY (CH), very stiff, gray, with root fibers to 6', ferrous and calcareous nodules	23								
					- stiff 4' to 6'									
5						17	79	23	56	98		102		
						16								
					- reddish brown 8' to 10'	15								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-15

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+44.76
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13782064.13
EASTING: 3168415.40
ELEVATION: 34.06'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	9								
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules	18	89	25	64	93		100		
5						16								
						16								
						15								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-16

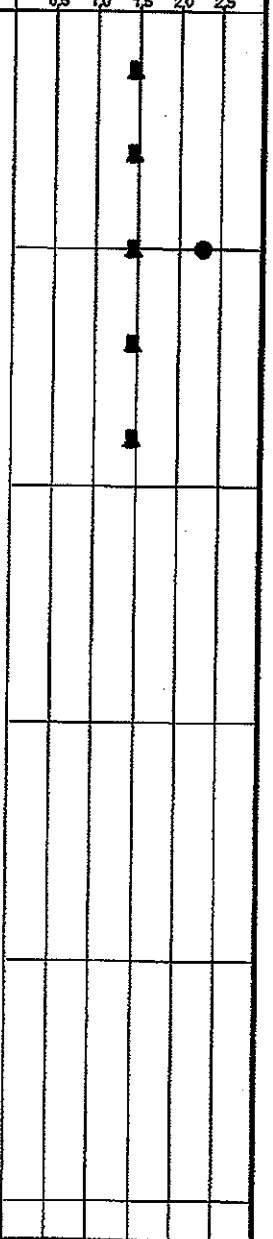
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 8+49.81
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782220.46
EASTING: 3168662.17
ELEVATION: 33.00'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	37								
					FAT CLAY (CH), very stiff, light gray, gray, with root fibers to 6", ferrous and calcareous nodules, moist	30								
					- hard 4' to 6'									
5						22	62	21	41	91		108		
						21								
					- reddish brown 8' to 10'	23								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-17

Sheet 1 of 1

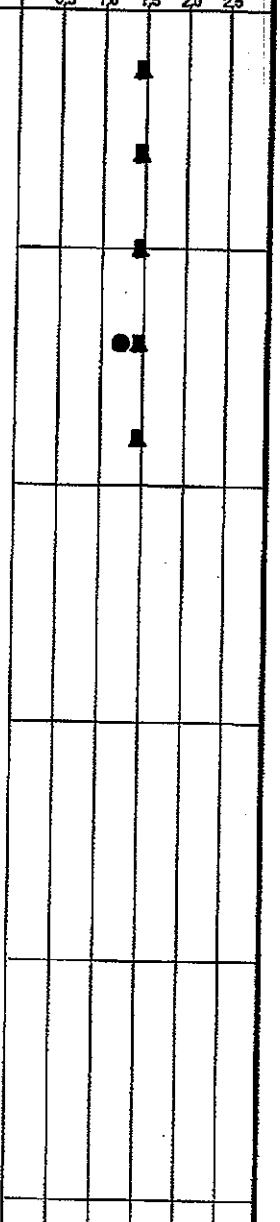
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+83.76
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782534.17
EASTING: 3168317.98
ELEVATION: 32.28'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	36								
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	31								
5						25								
					- reddish brown 6' to 10'	24	63	21	42	92		105		
						18								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVMA.GDT 8/15/14

LOG OF BORING NO. B-18

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+44.05
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13782301.31
EASTING: 3168992.79
ELEVATION: 31.90'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	27								
					FAT CLAY (CH), stiff, gray, reddish brown, with root fibers to 6', ferrous and calcareous nodules, moist	29	70	22	48	97		96		
					- very stiff 4' to 10'									
5						25								
						28								
						25								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-19

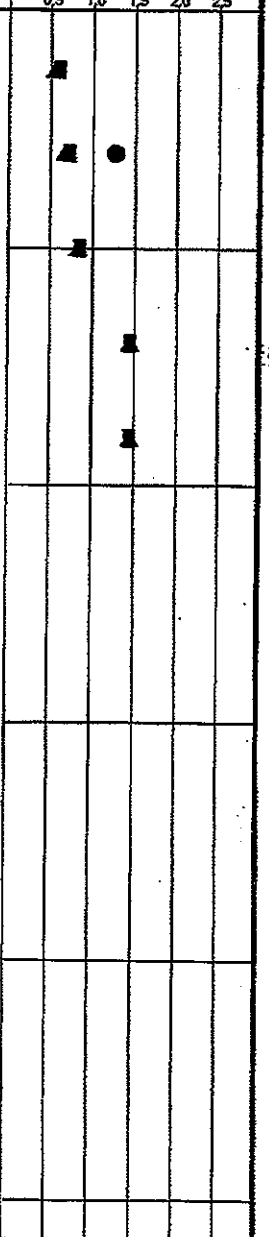
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+94.58
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782467.05
EASTING: 3168806.33
ELEVATION: 32.53'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, light gray, with root fibers, ferrous and calcareous nodules, moist	37								
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	25	60	20	40	91		102		
					- stiff 4' to 6'									
5						28								
					- reddish brown 6' to 10'									
						30								
						26								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-820E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-20

Sheet 1 of 1

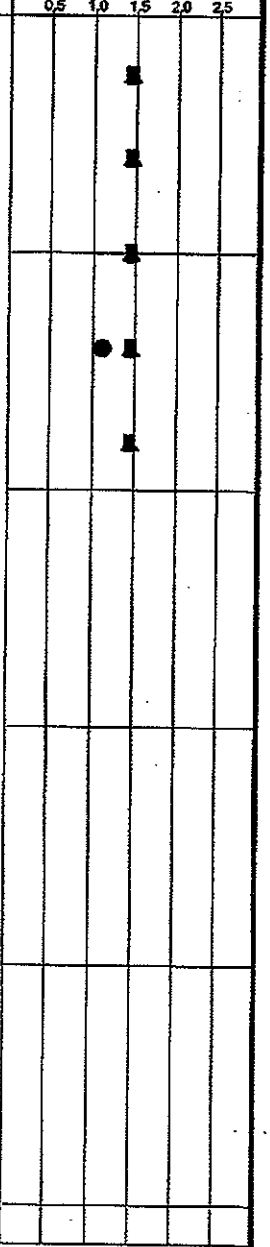
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+24.45
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782723.45
EASTING: 3168939.73
ELEVATION: 32.51'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	35								
					FAT CLAY (CH), very stiff, light brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	34								
5						35								
						29	79	23	56	98		93		
					- reddish brown 8' to 10'	31								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-21

Geotech Engineering and Testing
800 Victoria Drive.
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 4+61.72
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782900.30
EASTING: 3168745.77
ELEVATION: 32.33'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	31								
					FAT CLAY (CH), stiff, light gray, gray, with root fibers to 6', ferrous and calcareous nodules, moist	32								
					- very stiff 4' to 10'									
5						29	78	23	55	88		85		
					- reddish brown 6' to 10'	35								
						26								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320IE.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-22

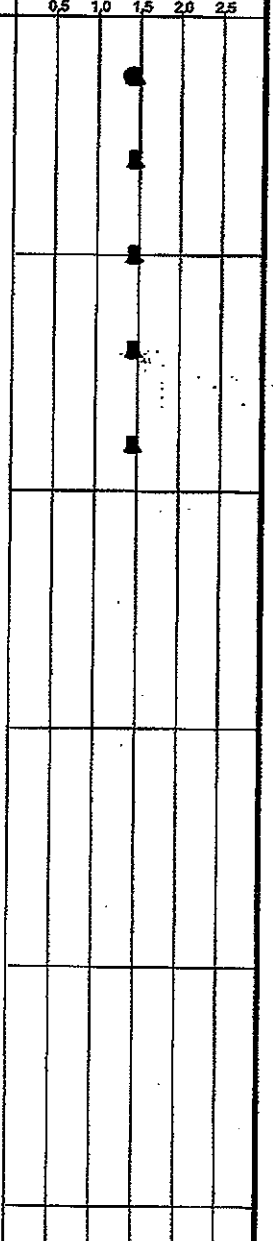
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+63.85
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782498.65
EASTING: 3169194.00
ELEVATION: 32.04'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	18	53	19	34	90		105		
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	20								
5						16								
					- reddish brown 6' to 10'	15								
						14								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-23

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 9+29.51
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782795.72
EASTING: 3169277.12
ELEVATION: 32.26'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	15							
					FAT CLAY (CH), very stiff, gray, brown, with root fibers to 6", ferrous and calcareous nodules, moist	18							
5						14	51	19	32	88	106		
					- reddish brown 8' to 10'	18							
						14							
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-24

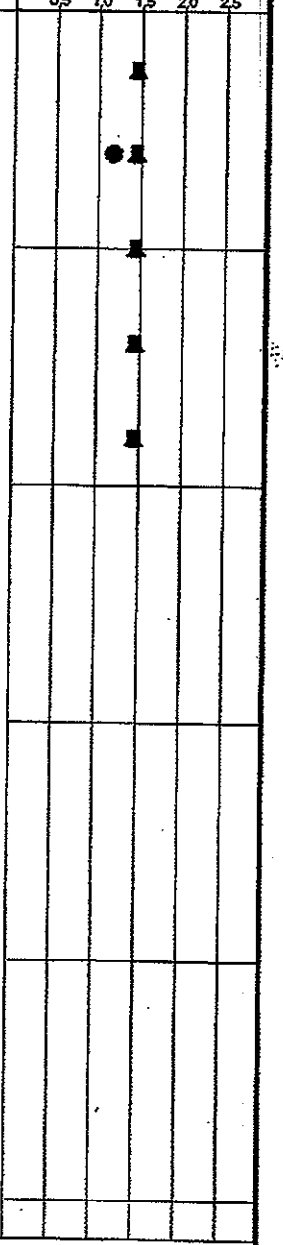
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 15+65.35
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782671.61
EASTING: 3169528.35
ELEVATION: 31.60'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	18								
					FAT CLAY (CH), very stiff, gray, light gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	15	52	19	33	89		106		
5						15								
						16								
					- reddish brown 8' to 10'	15								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/13/14

LOG OF BORING NO. B-25

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+07.30
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783140.99
EASTING: 3169312.64
ELEVATION: 32.19'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ■ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	24									■
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	24									■
					- reddish brown 4' to 10'										
5						27									■
						18	58	20	38	-89		103			● ■
						16									■
10															
15															
20															
25															

UNDRAINED SHEAR STRENGTH, tsf: 0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM/2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-26

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 4+28.98
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783329.51
EASTING: 3169108.35
ELEVATION: 31.08'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ▮ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	27									▮
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	24	64	21	43	91		101			● ▮
5						25									▮
					- reddish brown 6' to 10'	23									▮
						29									▮
10															
15															
20															
25															

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-27

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 6+24.95
DATE: 7-8-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13782847.41
EASTING: 3165687.46
ELEVATION: 35.67'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	27								
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6", ferrous and calcareous nodules, moist	26								
5						27								
						22	66	21	45	91		102		
						23								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: BJ

OVM2 14-320E.GPJ OVM.GDT 10/20/14

LOG OF BORING NO. B-28

Sheet 1 of 1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77040
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+23.95
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782584.48
EASTING: 3165987.58
ELEVATION: 35.08'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ■ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	28	64	21	43			100			
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	24									
5						30									
						16									
					- reddish brown 8' to 10'	25									
10															
15															
20															
25															

UNDRAINED SHEAR STRENGTH, tsf: 0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-920E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-29

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 14+64.41
DATE: 7-9-14 COMPLETION DEPTH: 16.0 ft.

NORTHING: 13782291.50
EASTING: 3166316.47
ELEVATION: 34.15

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ■ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 0.5, 1.0, 1.5, 2.0, 2.5)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	31									
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	29	98	26	72						
5						29									
						34									
					- reddish brown 8' to 16'	33									
10					- hard 10' to 12'	26	59	20	39			85			
						27									
15						24									
20															
25															

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 16 ft.
WET ROTARY: ____ TO ____ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-30

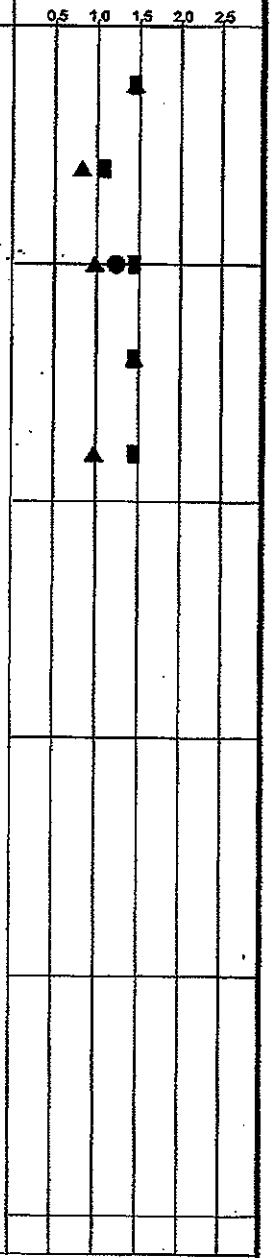
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 18+89.78
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782007.25
EASTING: 3166633.56
ELEVATION: 34.20'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	22								
					FAT CLAY (CH), stiff, gray, brown, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	29								
					- very stiff 4' to 10'									
5						25	66	21	45	87		99		
					- reddish brown 6' to 10'	18								
						28								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊙ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM/2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-31

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 12+59.94
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING:13782894.83
EASTING:3166343.75
ELEVATION: 34.00

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	16								
					FAT CLAY (CH), soft, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules	9								
					- very stiff 4' to 6'									
5						14	63	21	42					
					LEAN CLAY (CL), very stiff, reddish brown, with ferrous nodules	15								
					- hard 8' to 10'	10	40	17	23	98		122		
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL

0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-32

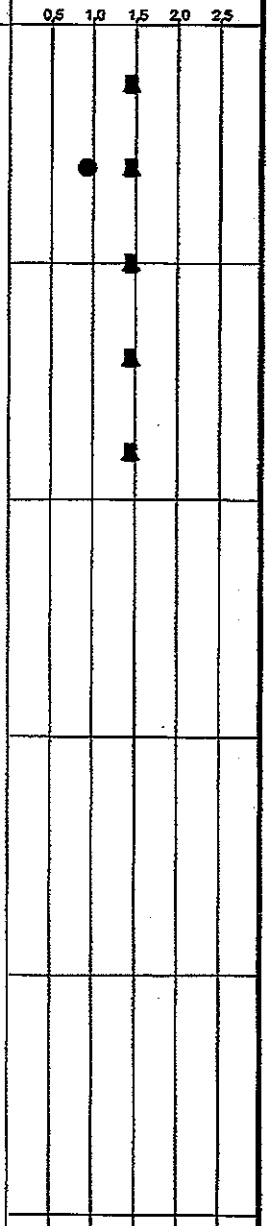
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+05.59
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783004.35
EASTING: 3165936.70
ELEVATION: 35.39'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	15								
					FAT CLAY (CH), stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules	18	51	19	32	92		97		
					- very stiff 4' to 10'									
5						15								
					- reddish brown 6' to 10'	17								
						16								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-33

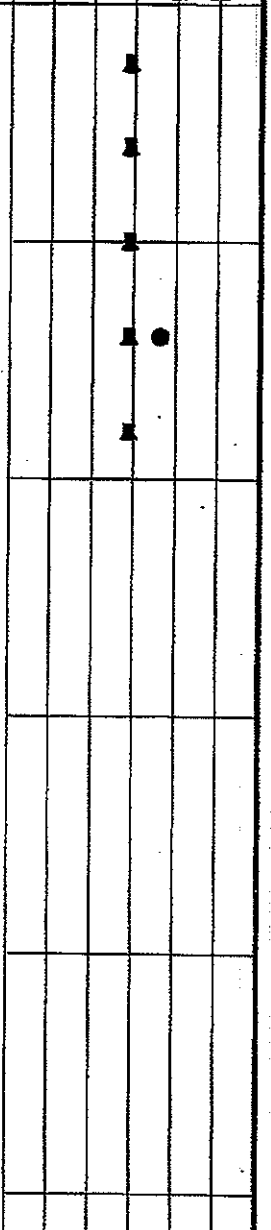
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+65.25
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORHTING:13783229.65
EASTING: 3165881.60
ELEVATION: 34.43'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, light brown, with root fibers, ferrous and calcareous nodules	14								
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules	12								
5						13								
						11	54	19	35	93		115		
						11								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-328E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-34

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 4+33.00
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13783393.77
EASTING: 3165919.96
ELEVATION: 34.57'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), soft, dark gray, with root fibers, ferrous and calcareous nodules, moist	29	53	19	34	90				
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	23								
5						27								
						25						107		
					- reddish brown 8' to 10'	19								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL

0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM/2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-35

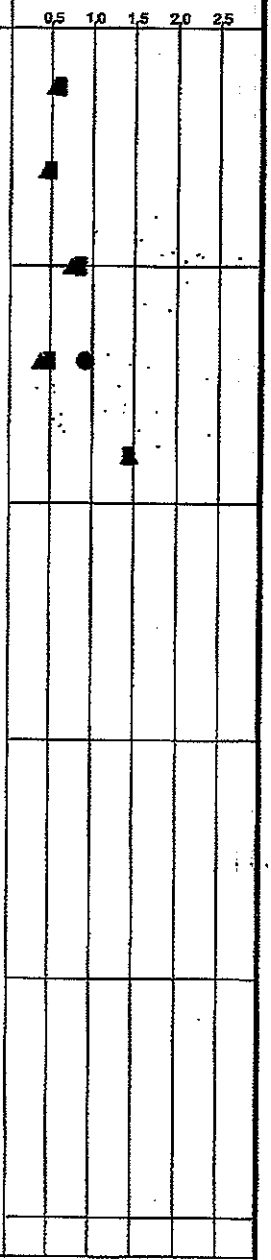
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+73.21
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13783166.89
EASTING: 3166173.55
ELEVATION: 35.15'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	26								
					FAT CLAY (CH), firm, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	31								
					- stiff 4' to 8'									
5						27								
						25	62	21	41	92		95		
					- very stiff 8' to 10'									
						18								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-36

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 16+46.15
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORHTING: 13782510.24
EASTING: 3166747.35
ELEVATION: 35.27'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	21								
					FAT CLAY (CH), very stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	26								
					- hard 4' to 6'									
5						26	87	25	62	99		98		
						23								
					- reddish brown 8' to 10'									
						18								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 10/28/14

LOG OF BORING NO. B-37

Sheet 1 of 1

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 19+88.63
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782235.76
EASTING: 3166951.71
ELEVATION: 34.04'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	18								
					FAT CLAY (CH), very stiff, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	29								
5						23	72	23	49			107		
					- stiff 6' to 8'	28								
					- reddish brown 8' to 10'	20								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM: 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-38

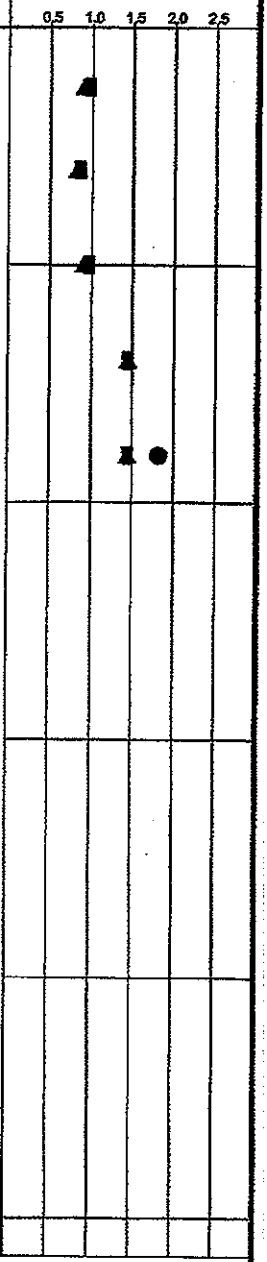
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 16+68.04
DATE: 7-9-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782685.27
EASTING: 3166967.65
ELEVATION: 34.02'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, gray, with root fibers, ferrous and calcareous nodules, moist	24								
					FAT CLAY (CH), stiff, gray, brown, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	25								
5						27								
					- very stiff 6' to 10'	25								
						34	67	20	47	99		107		
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-39

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+76.02
DATE: 7-9-14 COMPLETION DEPTH: 16.0 ft.

NORTHING: 13783040.15
EASTING: 3166861.56
ELEVATION: 33.00'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, gray, with root fibers, ferrous and calcareous nodules, moist	26								
					FAT CLAY (CH), stiff, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	30								
					- very stiff 4' to 16'									
5						24								
						24	54	19	35	93		116		
					- reddish brown 8' to 16'									
						27								
10														
						23								
						25								
15						27								
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
▽: WATER ENCOUNTERED AT 15.0 ft. DURING DRILLING
▼: WATER DEPTH AT 15.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 16 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-40

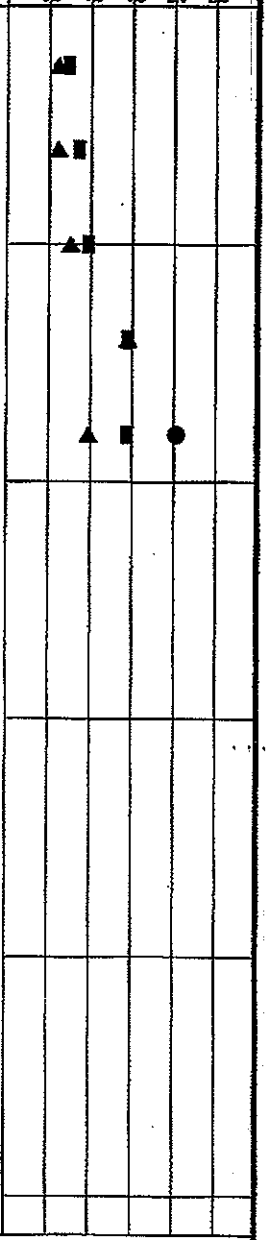
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0197-4 STATION NO.: 8+75.66
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783288.55
EASTING: 3166454.30
ELEVATION: 34.00'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, gray, with root fibers, ferrous and calcareous nodules, moist	26								
					FAT CLAY (CH), stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	27	70	22	48	89				
5						27								
					- very stiff 6' to 8'	25								
					- hard 8' to 10'	25						93		
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-41

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 4+17.27
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783594.96
EASTING: 3166113.11
ELEVATION: 33.34'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), firm, dark gray, with root fibers, ferrous and calcareous nodules, moist	28								
					FAT CLAY (CH), stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	24								
					- very stiff 4' to 10'									
5						26								
						24	62	21	41	87		92		
						27								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, ksf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-42

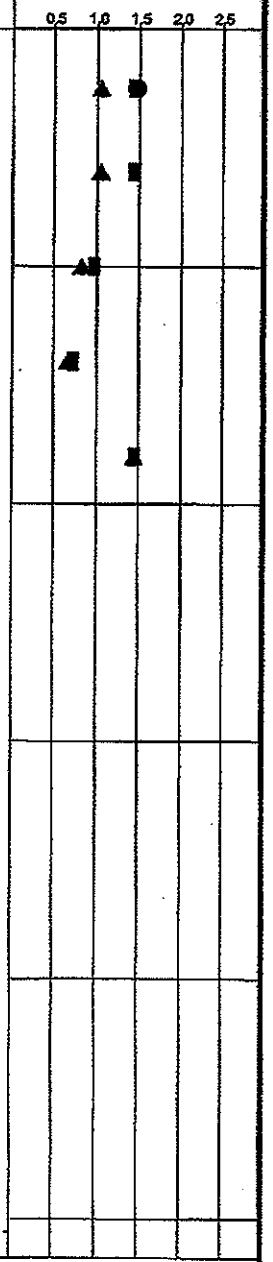
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 1+92.67
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783745.36
EASTING:3165946.28
ELEVATION: 32.79'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), very stiff, gray, with root fibers, ferrous and calcareous nodules, moist	28	76	23	53	96		93	
					FAT CLAY (CH), very stiff, light brown, brown, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	29							
					- stiff 4' to 8'								
5						28							
						28							
					- reddish brown 8' to 10'								
						26							
10													
15													
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM/2 14-320B.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-43

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 2+31.78
DATE: 7-10-14 COMPLETION DEPTH: 16.0 ft.

NORTHING: 13784016.97
EASTING: 3166209.03
ELEVATION: 31.92'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	30								
					FAT CLAY (CH), stiff, light brown, brown, gray, dark gray, with root fibers to 6", ferrous and calcareous nodules, moist	33	65	21	44					
5						30								
						26								
					- reddish brown 8' to 16'	32								
10						29								
					- very stiff 12' to 16'	34	71	22	49	90		91		
15						31								
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
▽ : WATER ENCOUNTERED AT 15.0 ft. DURING DRILLING
▼ : WATER DEPTH AT 15.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 16 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-44

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 7+67.70
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783661.67
EASTING: 3166610.29
ELEVATION: 33.60'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	31								
					FAT CLAY (CH), stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	33								
					- very stiff 4' to 8'									
5						31	80	25	55	84		92		
						24								
						36								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-45

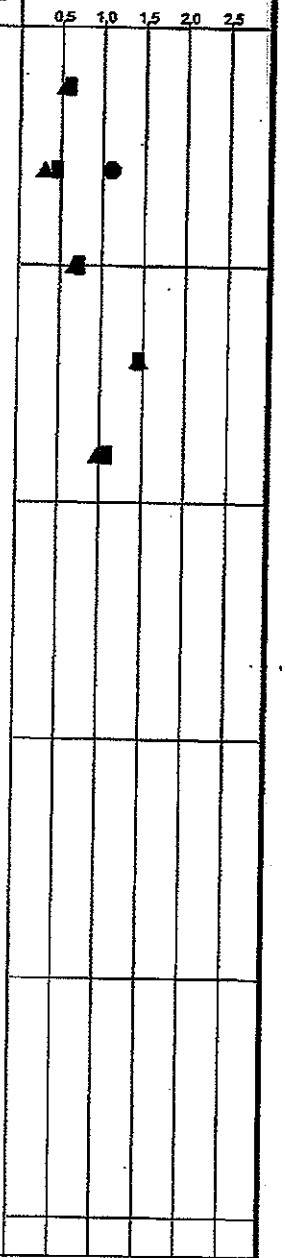
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+16.43
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING:13783490.48
EASTING:3166791.14
ELEVATION: 32.66

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	35								
					FAT CLAY (CH), very stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	36	88	26	62	96		92		
					- stiff 4' to 6'	33								
5						21								
					- reddish brown 8' to 10'	29								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
▮ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/18/14

LOG OF BORING NO. B-46

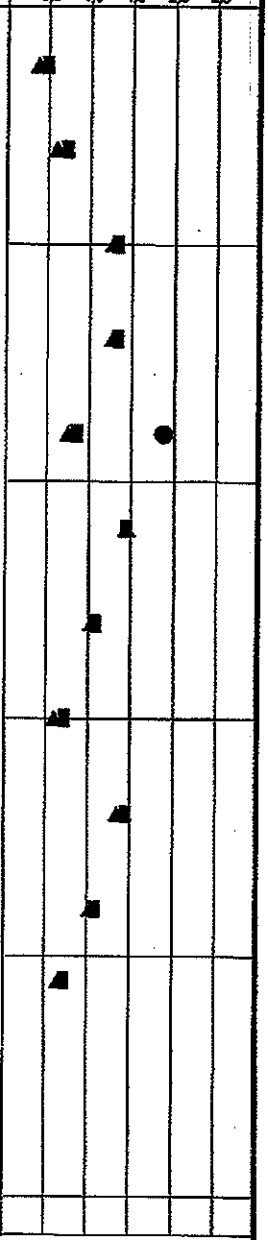
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 12+15.90
DATE: 7-10-14 COMPLETION DEPTH: 21.0 ft.

NORTHING: 13783144.10
EASTING: 3166955.15
ELEVATION: 32.79'

DEPTH, ft	SPT N-VALUE, blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), firm, brown, dark gray, with root fibers, ferrous and calcareous nodules, moist	32	80	24	56					
					FAT CLAY (CH), stiff, light brown, brown, gray, dark gray, with root fibers to 6', ferrous and calcareous nodules, moist	25								
					- very stiff 4' to 8'									
5						23								
						24								
					- hard 8' to 10'									
						24	75	23	52	97		100		
10					- very stiff 10' to 14'									
						24								
						23								
15						26								
					- very stiff 16' to 20'									
						21								
						20								
20						24								
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
▽: WATER ENCOUNTERED AT 14.0 ft. DURING DRILLING
▼: WATER DEPTH AT 14.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 14 ft.
WET ROTARY: 14 TO 21 ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-47

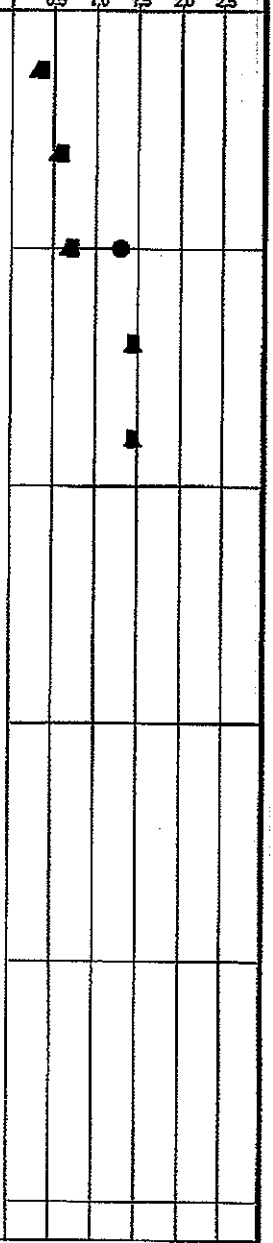
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 17+88.63
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13782874.66
EASTING: 3167253.98
ELEVATION: 33.51'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), firm, gray, with root fibers, ferrous and calcareous nodules, moist	28								
					FAT CLAY (CH), stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	25								
					- very stiff 4' to 10'									
5						18	79	25	54	92		107		
						20								
						19								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/16/14

LOG OF BORING NO. B-48

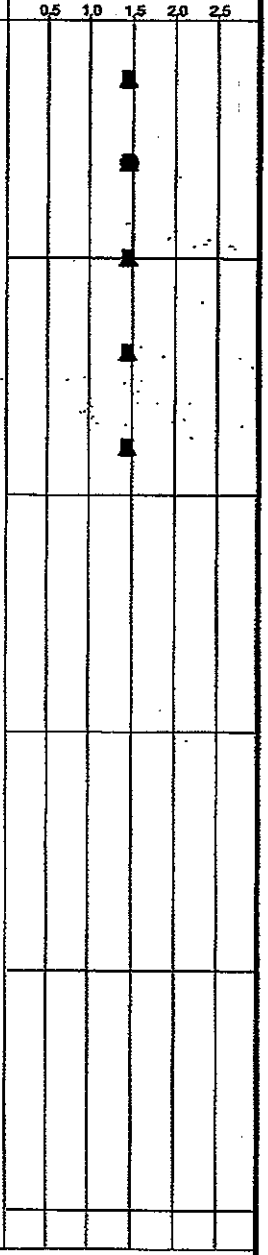
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 17+04.49
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13783175.82
EASTING: 3167425.30
ELEVATION: 33.07'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")									
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	21								
					FAT CLAY (CH), very stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	19	92	26	66	96		92		
5						18								
					- reddish brown 6' to 10'	19								
						20								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM: 14-320E.GPJ OVM.GDT 8/15/14

LOG OF BORING NO. B-49

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 16+68.96
DATE: 7-10-14 COMPLETION DEPTH: 17.0 ft.

NORTHING: 13783484.63
EASTING: 3167254.00
ELEVATION: 32.26

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)
0					CONCRETE PAVEMENT (7.0")								
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules	18							
					FAT CLAY (CH), very stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	24							
5						19							
					- hard 6' to 8'	16	96	27	69	86	103		
					- reddish brown 8' to 17'	18							
10						19							
						25							
15						16	75	24	51				
						23							
20													
25													

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
0.5 1.0 1.5 2.0 2.5

WATER OBSERVATIONS:
▽ : WATER ENCOUNTERED AT 15.0 ft. DURING DRILLING
▼ : WATER DEPTH AT 15.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 17 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-50

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 10+21.43
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING:13783695.47
EASTING:3166981.86
ELEVATION: 33.37

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ▮ TORVANE, ● UNCONFINED COMPRESSION, ⊖ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	29									
					FAT CLAY (CH), hard, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	27	103	28	75	95		98			
					- very stiff 4' to 10'										
5						26									
					- reddish brown 6' to 10'	33									
						28									
10															
15															
20															
25															

Scale: 0.5, 1.0, 1.5, 2.0, 2.5

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-51

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.: 3+04.23
DATE: 7-10-14 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13784177.93
EASTING: 3165450.88
ELEVATION: 33.13

DEPTH, ft	SPT NAVALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf (▲ HAND PENETROMETER, ■ TORVANE, ● UNCONFINED COMPRESSION, ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
0					CONCRETE PAVEMENT (7.0")										
					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	30									■
					FAT CLAY (CH), very stiff, light brown, brown, gray, with root fibers to 6', ferrous and calcareous nodules, moist	31									■
5						28									■
					- reddish brown 6' to 10'	33									■
					- hard 8' to 10'	24	82	24	58	92		99			■ ●
10															
15															
20															
25															

WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jr.

OVM2 14-320E.GPJ OVM.GDT 8/19/14

LOG OF BORING NO. B-3A

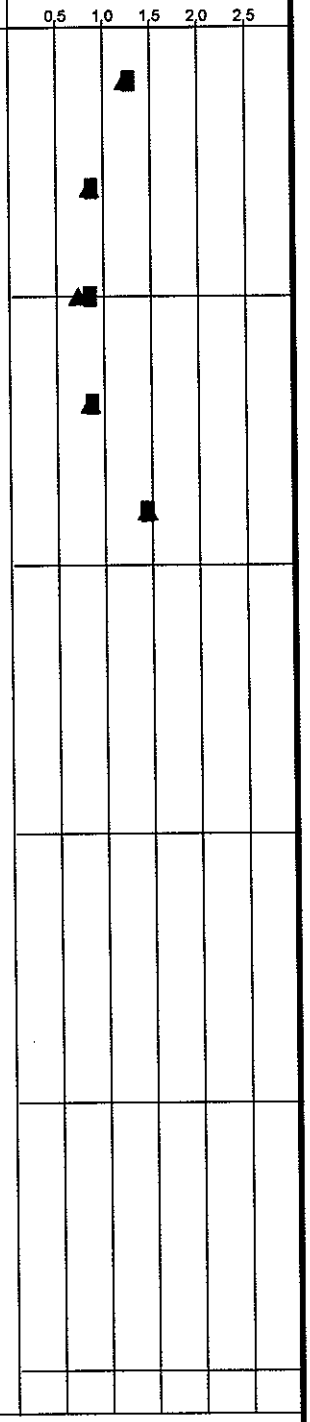
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.:
DATE: 6-25-15 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780830.88
EASTING: 3167990.01
ELEVATION: 33.05'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	CORING LENGTH, in	CORING RECOVERY LENGTH, in	RQD LENGTH, in	RQD-ROCK QUALITY DESEGNATION, %
0					FILL: FAT CLAY (CH), very stiff, dark gray, with root fibers, ferrous and calcareous nodules, moist	28								
					FAT CLAY (CH), stiff, gray, dark gray, brown, with root fibers to 6', ferrous and calcareous nodules, moist	29								
5						30	75	23	52					
						30								
					- very stiff 8' to 10'	31								
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jeff

OVM3 14-320A.GPJ OVM.GDT 11/20/15

LOG OF BORING NO. B-4A

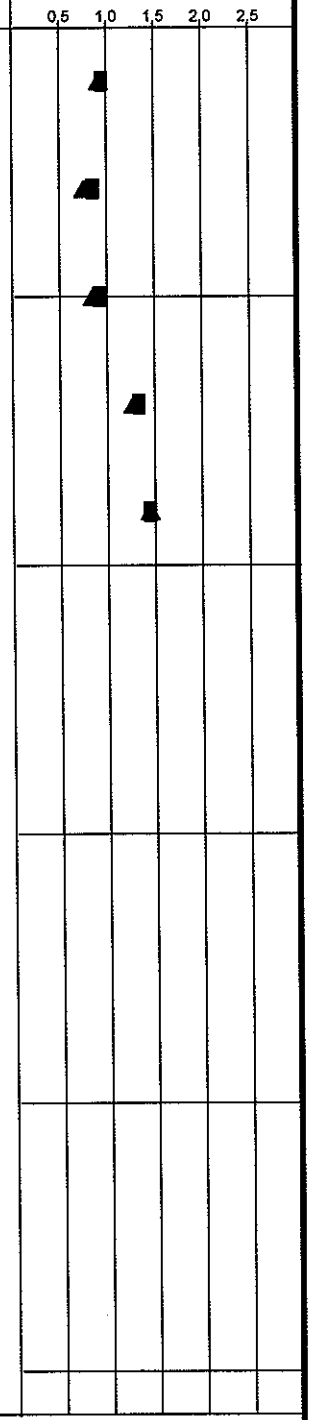
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.:
DATE: 6-25-15 COMPLETION DEPTH: 10.0 ft.

NORTHING: 13780782.80
EASTING: 3168044.24
ELEVATION: 32.79'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	CORING LENGTH, in	CORING RECOVERY LENGTH, in	RQD LENGTH, in	RQD-ROCK QUALITY DESEGNATION, %
0					FILL: FAT CLAY (CH), stiff, light gray, dark brown, with root fibers, ferrous and calcareous nodules	28								
					FAT CLAY (CH), stiff, light brown, dark brown, with root fibers to 6', ferrous and calcareous nodules, moist	32								
5						29								
					- very stiff 6' to 10'	28								
					- reddish brown 8' to 10'	25	65	22	43					
10														
15														
20														
25														

UNDRAINED SHEAR STRENGTH, tsf
▲ HAND PENETROMETER
■ TORVANE
● UNCONFINED COMPRESSION
○ UNCONSOLIDATED-UNDRAINED TRIAXIAL



WATER OBSERVATIONS:
NO FREE WATER ENCOUNTERED DURING DRILLING

DRY AUGER: 0 TO 10 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jeff

OVM3 14-320A.GPJ OVM.GDT 11/20/15

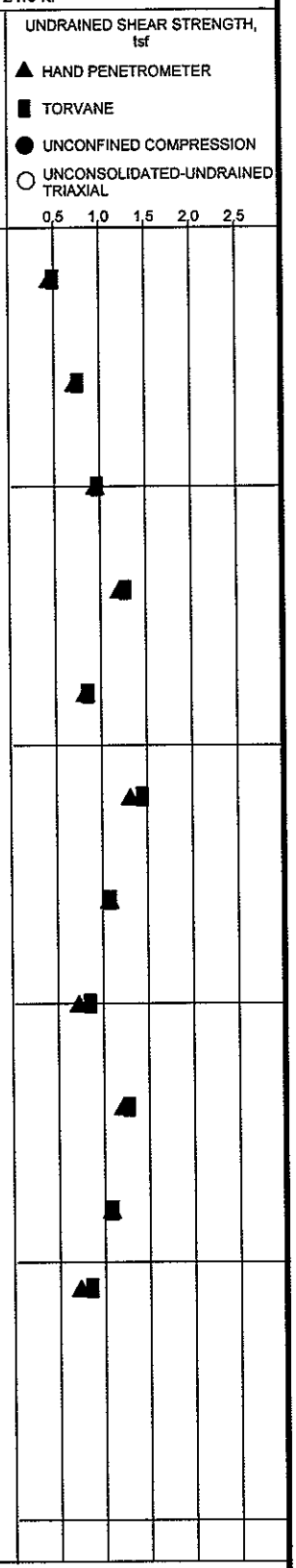
LOG OF BORING NO. B-46A

Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022
Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Water Lines Replacement at Hughes Road Area
LOCATION: City of Houston, Texas
PROJECT NO.: S-000035-0187-4 STATION NO.:
DATE: 6-25-15 COMPLETION DEPTH: 21.0 ft.

NORTHING: 13783080.98
EASTING: 3166919.36
ELEVATION: 33.00'

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	CORING LENGTH, in	CORING RECOVERY LENGTH, in	RQD LENGTH, in	RQD-ROCK QUALITY DESEGNATION, %
0					FILL: FAT CLAY (CH), firm, dark brown, with root fibers, ferrous and calcareous nodules, moist	27	74	23	51					
					FAT CLAY (CH), stiff, gray, dark gray, brown, with root fibers to 6', ferrous and calcareous nodules, moist	24								
5						22								
					- very stiff 6' to 8'	21								
						23	76	23	53					
10					- very stiff 10' to 14'	24								
						22								
15						27								
					- very stiff 16' to 20'	27								
						28								
20						26								
25														



WATER OBSERVATIONS:
▽: WATER ENCOUNTERED AT 21.0 ft. DURING DRILLING.
▼: WATER DEPTH AT 21.0 ft. AFTER 0.33 HOUR

DRY AUGER: 0 TO 21 ft.
WET ROTARY: ___ TO ___ ft.

DRILLED BY: GET (T)
LOGGED BY: Jeff

OVM3 14-320A.GPJ OVM.GDT 11/20/15

KEY TO LOG TERMS AND SYMBOLS

UNIFIED SOIL CLASSIFICATIONS

Symbol	Material Descriptions
GW	WELL GRADED-GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL-SAND SILT MIXTURES
GC	CLAY GRAVELS, GRAVEL-SAND CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, OR GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND-SILT MIXTURES a
SC	CLAYEY SANDS, SAND-SILT MIXTURES b
ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT
	FILL SOILS

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	-	Having incline planes of weakness that are slick and glossy in appearance.
Fissured	-	Containing shrinkage cracks frequently filled with fine sand or silt: usually vertical.
Laminated	-	Composed of thin layers of varying colors and soil sample texture.
Interbedded	-	Composed of alternate layers of different soil types.
Calcareous	-	Containing appreciable quantities of calcium carbonate.
Well Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly Graded	-	Predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.
Pocket	-	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	-	Inclusion less than ⅛-inch thick extending through the sample.
Seam	-	Inclusion ⅛- to 3-inch thick extending through the sample.
Layer	-	Inclusion greater than 3-inch thick extending through the sample.
Interlayered	-	Soils sample composed of alternating layers of different soil types.
Intermixed	-	Soil samples composed of pockets of different soil type and layered or laminated structure is not evident.

COARSE GRAINED SOILS (major portion retained on No. 200 Sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Conditions rated according to standard penetration test (SPT)* as performed in the field.

Descriptive Terms	Blows Per Foot*
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	over 50

* 140 pound weight having a free fall of 30-inch

FINE GRAINED SOILS (major portion passing No. 200 Sieve): Include (1) inorganic or organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength as indicated by hand penetrometer readings or by unconfined compression tests.

Descriptive Term	Undrained Shear Strength Ton/Sq. Ft.
Very Soft	Less than 0.13
Soft	0.13 to 0.25
Firm	0.25 to 0.50
Stiff	0.50 to 1.00
Very Stiff	1.00 to 2.00
Hard	2.00 or higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of weakness or cracks in the soil. The consistency ratings of such soils are based on hand penetrometer readings.

SOIL SAMPLERS

- SHELBY TUBE SAMPLER
- STANDARD PENETRATION TEST
- AUGER SAMPLING

TERMS CHARACTERIZING ROCK PROPERTIES

VERY SOFT OR PLASTIC	Can be remolded in hand: corresponds in consistency up to very stiff in soils.
SOFT	Can be scratched with fingernail.
MODERATELY HARD	Can be scratched easily with knife; cannot be scratched with fingernail. Difficult to scratch with knife.
VERY HARD	Cannot be scratched with knife.
POORLY CEMENTED OR FRIABLE	Easily crumbled.
CEMENTED	Bounded Together by chemically precipitated materials.
UNWEATHERED	Rock in its natural state before being exposed to atmospheric agents.
SLIGHTLY WEATHERED	Noted predominantly by color change with no disintegrated zones.
WEATHERED	Complete color change with zones of slightly decomposed rock.
EXTREMELY WEATHERED	Complete color change with consistency, texture, and general appearance or soil.

SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-1	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		31								0.62	0.56	Fill: Fat Clay (CH)
	3	2	4	UD		30	101	59	23	36	92	1.03		0.5	0.46	Fat Clay (CH)
	4	4	6	UD		32								0.62	0.56	Fat Clay (CH)
	5	6	8	UD		21								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		27								1.5	1.5	Fat Clay (CH)
B-2	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		30								0.5	0.46	Fill: Fat Clay (CH)
	3	2	4	UD		31								0.75	0.62	Fat Clay (CH)
	4	4	6	UD		33	106	76	23	53	92	1.44		0.5	0.46	Fat Clay (CH)
	5	6	8	UD		33								0.88	0.78	Fat Clay (CH)
	6	8	10	UD		21								1.5	1.5	Fat Clay (CH)

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SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-3	1	0	0.7													Concrete Pavement
	2	0.7	2	UD		29								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		30								0.88	0.78	Fat Clay (CH)
	4	4	6	UD		29	102	73	22	51	87	1.57		0.75	0.62	Fat Clay (CH)
	5	6	8	UD		27								0.88	0.78	Fat Clay (CH)
	6	8	10	UD		30								1.5	1.5	Fat Clay (CH)
B-4	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		26								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		33								0.88	0.85	Fat Clay (CH)
	4	4	6	UD		30								1	0.93	Fat Clay (CH)
	5	6	8	UD		26	97	61	21	40	88	1.88		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		22								1.5	1.5	Fat Clay (CH)

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BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETROMETER	TYPE OF MATERIAL
B-5	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		30								0.62	0.56	Fill: Fat Clay (CH)
	3	2	4	UD		26	100	68	22	46	99	1.48		0.88	0.78	Fat Clay (CH)
	4	4	6	UD		26								0.75	0.62	Fat Clay (CH)
	5	6	8	UD		33								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		29								1.5	1.5	Fat Clay (CH)
B-6	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		27	97	74	23	51		1.72		1.12	1.01	Fill: Fat Clay (CH)
	3	2	4	UD		33								0.88	0.78	Fat Clay (CH)
	4	4	6	UD		31								1	0.93	Fat Clay (CH)
	5	6	8	UD		33								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		23								1.5	1.5	Fat Clay (CH)

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B-7	1	0	0.6													Concrete Pavement
	2	0.6	1.4	UD		15								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		8								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		15								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		15								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		12	109	66	21	45		1.14		1.5	1.5	Fat Clay (CH)
B-8	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		24								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		13								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		11	108	51	19	32	88	1.87		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		12								1.5	1.5	Fat Clay (CH)

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B-9	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		16								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		12								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		13								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		10								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		17	104	52	19	33	86	2.32		1.5	1.5	Fat Clay (CH)
B-10	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		15								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		19								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		14	109	52	19	33	92	1.03		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		13								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		17								1.5	1.5	Fat Clay (CH)

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B-11	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		16								1.5	1.5	Fill: Lean Clay (CL)
	3	2	4	UD		14								1.5	1.5	Lean Clay (CL)
	4	4	6	UD		13	109	44	18	26	86	2.01		1.5	1.5	Lean Clay (CL)
	5	6	8	UD		16								1.5	1.5	Lean Clay (CL)
	6	8	10	UD		16								1.5	1.5	Lean Clay (CL)
B-12	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		13								1.5	1.5	Fill: Lean Clay (CL)
	3	2	4	UD		13								1.5	1.5	Lean Clay (CL)
	4	4	6	UD		17								1.5	1.5	Lean Clay (CL)
	5	6	8	UD		16	106	48	18	30	89	2.5		1.5	1.5	Lean Clay (CL)
	6	8	10	UD		14								1.5	1.5	Lean Clay (CL)

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B-13	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		13	106	78	23	55	96	2.06		1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		15								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		18								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		15								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		15								1.5	1.5	Fat Clay (CH)
B-14	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		18								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		23								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		17	102	79	23	56	98	0.78		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		15								1.5	1.5	Fat Clay (CH)

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B-15	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		9								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		18	100	89	25	64	93	1.13		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		16								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		15								1.5	1.5	Fat Clay (CH)
B-16	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		37								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		30								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		22	108	62	21	41	91	2.38		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		21								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		23								1.5	1.5	Fat Clay (CH)

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BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	ATTERBERG LIMITS PL (%)	ATTERBERG LIMITS PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	SHEAR STRENGTH (TSF) UU TEST (CONFINING PRESSURE. TSF)	SHEAR STRENGTH (TSF) TORVANE	SHEAR STRENGTH (TSF) POCKET PENETRO METER	TYPE OF MATERIAL
B-17	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		36								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		31								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		25								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		24	105	63	21	42	92	1.27		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		18								1.5	1.5	Fat Clay (CH)
B-18	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		27								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		29	96	70	22	48	97	0.62		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		25								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		29								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		25								1.5	1.5	Fat Clay (CH)

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B-19	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		37								0.62	0.56	Fill: Fat Clay (CH)
	3	2	4	UD		25	102	60	20	40	91	1.31		0.75	0.69	Fat Clay (CH)
	4	4	6	UD		28								0.88	0.85	Fat Clay (CH)
	5	6	8	UD		30								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		26								1.5	1.5	Fat Clay (CH)
B-20	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		35								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		34								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		35								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		29	93	79	23	56	98	1.15		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		31								1.5	1.5	Fat Clay (CH)

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B-21	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		31								1.12	1.01	Fill: Fat Clay (CH)
	3	2	4	UD		32								0.75	0.62	Fat Clay (CH)
	4	4	6	UD		29	85	78	23	55	88	1.44		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		35								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		26								1.5	1.5	Fat Clay (CH)
B-22	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		18	105	53	19	34	90	1.45		1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		20								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		16								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		15								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		14								1.5	1.5	Fat Clay (CH)

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B-23	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		15								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		18								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		14	106	51	19	32	88	1.2		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		18								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		14								1.5	1.5	Fat Clay (CH)
B-24	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		18								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		15	106	52	19	33	89	1.2		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		15								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		15								1.5	1.5	Fat Clay (CH)

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B-25	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		24								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		24								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		27								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		18	103	58	20	38	89	1.16		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		16								1.5	1.5	Fat Clay (CH)
B-26	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		27								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		24	101	64	21	43	91	1.11		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		25								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		23								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		29								1.5	1.5	Fat Clay (CH)

LEGEND:

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SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-27	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		27								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		26								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		27								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		22	102	66	21	45	91	1.93		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		23								1.5	1.5	Fat Clay (CH)
B-28	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		28	100	64	21	43		1.46		1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		24								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		30								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		25								1.5	1.5	Fat Clay (CH)

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CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-29	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		31								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		29		98	26	72				1.5	1.5	Fat Clay (CH)
	4	4	6	UD		29								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		34								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		33								1.5	1.5	Fat Clay (CH)
	7	10	12	UD		26	85	58	20	39		2.5		1.5	1.5	Fat Clay (CH)
	8	12	14	UD		27								1.5	1.5	Fat Clay (CH)
	9	14	16	UD		24								1.5	1.5	Fat Clay (CH)
B-30	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		22								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		29								1.12	0.85	Fat Clay (CH)
	4	4	6	UD		25	99	66	21	45	87	1.27		1.5	1.01	Fat Clay (CH)
	5	6	8	UD		18								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		28								1.5	1.01	Fat Clay (CH)

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B-31	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		16								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		9								0.31	0.25	Fat Clay (CH)
	4	4	6	UD		14		63	21	42				1.5	1.5	Fat Clay (CH)
	5	6	8	UD		15								1.5	1.5	Lean Clay (CL)
	6	8	10	UD		10	122	40	17	23	98	2.5		1.5	1.5	Lean Clay (CL)
B-32	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		15								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		18	97	51	19	32	92	0.96		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		15								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		17								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		16								1.5	1.5	Fat Clay (CH)

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B-33	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		14								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		12								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		13								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		11	115	54	19	35	93	1.89		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		11								1.5	1.5	Fat Clay (CH)
B-34	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		29		53	19	34				0.25	0.15	Fill: Fat Clay (CH)
	3	2	4	UD		23								1.38	1.32	Fat Clay (CH)
	4	4	6	UD		27								1.12	1.01	Fat Clay (CH)
	5	6	8	UD		25	107					1.93		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		19								1.5	1.5	Fat Clay (CH)

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BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-35	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		26								0.62	0.56	Fill: Fat Clay (CH)
	3	2	4	UD		31								0.5	0.46	Fat Clay (CH)
	4	4	6	UD		27								0.88	0.78	Fat Clay (CH)
	5	6	8	UD		25	95	62	21	41	92	0.95		0.5	0.39	Fat Clay (CH)
	6	8	10	UD		18								1.5	1.5	Fat Clay (CH)
B-36	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		21								0.75	0.62	Fill: Fat Clay (CH)
	3	2	4	UD		26								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		26	98	87	25	62	99	2.50		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		23								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		18								1.5	1.5	Fat Clay (CH)

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B-37	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		18								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		29								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		23	107	72	23	49		1.89		1.5	1.5	Fat Clay (CH)
	5	6	8	UD		28								0.88	0.78	Fat Clay (CH)
	6	8	10	UD		20								1.5	1.5	Fat Clay (CH)
B-38	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		24								1	0.93	Fill: Fat Clay (CH)
	3	2	4	UD		25								0.88	0.85	Fat Clay (CH)
	4	4	6	UD		27								1	0.93	Fat Clay (CH)
	5	6	8	UD		25								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		34	107	67	20	47	99	1.9		1.5	1.5	Fat Clay (CH)

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B-39	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		26								0.88	0.78	Fill: Fat Clay (CH)
	3	2	4	UD		30								0.88	0.78	Fat Clay (CH)
	4	4	6	UD		24								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		24								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		27	116	54	19	35	93	1.87		1.5	1.5	Fat Clay (CH)
	7	10	12	UD		23								1.25	1.12	Fat Clay (CH)
	8	12	14	UD		25								1.5	1.5	Fat Clay (CH)
	9	14	16	UD		27								1.5	1.5	Fat Clay (CH)
B-40	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		26								0.75	0.62	Fill: Fat Clay (CH)
	3	2	4	UD		27		70	22		90			0.88	0.62	Fat Clay (CH)
	4	4	6	UD		27								1	0.78	Fat Clay (CH)
	5	6	8	UD		25	93					2.11		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		25								1.5	1.01	Fat Clay (CH)

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B-41	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		28								0.5	0.46	Fill: Fat Clay (CH)
	3	2	4	UD		24								0.88	0.62	Fat Clay (CH)
	4	4	6	UD		26								1.5	1.24	Fat Clay (CH)
	5	6	8	UD		24	92	62	21	41	87	1.18		0.88	0.69	Fat Clay (CH)
	6	8	10	UD		27								1.5	1.32	Fat Clay (CH)
B-42	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		28	93	76	23	53	96	1.53		1.5	1.08	Fill: Fat Clay (CH)
	3	2	4	UD		29								1.5	1.08	Fat Clay (CH)
	4	4	6	UD		28								1	0.85	Fat Clay (CH)
	5	6	8	UD		28								0.75	0.69	Fat Clay (CH)
	6	8	10	UD		26								1.5	1.5	Fat Clay (CH)

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B-43	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		30								0.75	0.69	Fill: Fat Clay (CH)
	3	2	4	UD		33		65	21	44				0.75	0.56	Fat Clay (CH)
	4	4	6	UD		30								0.88	0.78	Fat Clay (CH)
	5	6	8	UD		26								1.12	0.93	Fat Clay (CH)
	6	8	10	UD		32								1	0.85	Fat Clay (CH)
	8	10	12	UD		29								0.75	0.69	Fat Clay (CH)
	9	12	14	UD		34	91	71	22	49	90	1.13		1.5	1.01	Fat Clay (CH)
	10	14	16	UD		31								1.5	1.08	Fat Clay (CH)
B-44	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		31								0.75	0.62	Fill: Fat Clay (CH)
	3	2	4	UD		33								0.75	0.69	Fat Clay (CH)
	4	4	6	UD		31	92	80	25	55	94	1.46		1	0.93	Fat Clay (CH)
	5	6	8	UD		24								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		36								0.75	0.62	Fat Clay (CH)

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B-45	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		35								0.56	0.62	Fill: Fat Clay (CH)
	3	2	4	UD		36	92	88	26	62	96	1.14		0.46	0.31	Fat Clay (CH)
	4	4	6	UD		33								0.69	0.75	Fat Clay (CH)
	5	6	8	UD		21								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		29								1.01	1.12	Fat Clay (CH)

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B-46	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		32		80	24	56				0.5	0.39	Fill: Fat Clay (CH)
	3	2	4	UD		25								0.75	0.62	Fat Clay (CH)
	4	4	6	UD		23								1.38	1.32	Fat Clay (CH)
	5	6	8	UD		24								1.38	1.32	Fat Clay (CH)
	6	8	10	UD		24	100	75	23	52	97	1.95		0.88	0.78	Fat Clay (CH)
	8	10	12	UD		24								1.5	1.5	Fat Clay (CH)
	9	12	14	UD		23								1.12	1.08	Fat Clay (CH)
	10	14	16	UD		26								0.75	0.62	Fat Clay (CH)
	11	16	18	UD		21								1.5	1.4	Fat Clay (CH)
	12	18	20	UD		20								1.12	1.08	Fat Clay (CH)
	13	20	21	UD		24								0.75	0.69	Fat Clay (CH)

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	COH WBS NUMBER: S-00035-0187-4
Geotechnical Consultant's Name: Geotech Engineering and Testing	CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	ATTERBERG LIMITS PL (%)	ATTERBERG LIMITS PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	SHEAR STRENGTH (TSF) UU TEST (CONFINING PRESSURE. TSF)	SHEAR STRENGTH (TSF) TORVANE	SHEAR STRENGTH (TSF) POCKET PENETRO METER	TYPE OF MATERIAL
B-47	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		28								0.38	0.31	Fill: Fat Clay (CH)
	3	2	4	UD		25								0.62	0.56	Fat Clay (CH)
	4	4	6	UD		18	107	79	25	54	92	1.34		0.75	0.69	Fat Clay (CH)
	5	6	8	UD		20								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		19								1.5	1.5	Fat Clay (CH)
B-48	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		21								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		19	92	92	26	66	96	1.51		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		18								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		19								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		20								1.5	1.5	Fat Clay (CH)

LEGEND:			NOTES:
	UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD	LL = LIQUID LIMIT	
	SS = SPLIT SPOON SAMPLE	PL = PLASTIC LIMIT	
	AG = AUGER CUTTINGS	PI = PLASTIC INDEX	
	SPT = STANDARD PENETRATION TEST	UU = TRIAXIAL COMPRESSION	

SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-49	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		18								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		24								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		19								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		16	103	96	27	69	86	2.5		1.5	1.5	Fat Clay (CH)
	6	8	10	UD		18								1.5	1.5	Fat Clay (CH)
	8	10	12	UD		19								1.5	1.5	Fat Clay (CH)
	9	12	14	UD		25								1.5	1.5	Fat Clay (CH)
	10	14	16	UD		16								1.5	1.5	Fat Clay (CH)
	11	16	17	UD		23								1.5	1.5	
B-50	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		29								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		27	98	103	28	75	95	2.5		1.5	1.5	Fat Clay (CH)
	4	4	6	UD		26								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		33								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		28								1.5	1.5	Fat Clay (CH)

LEGEND:

UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD

SS = SPLIT SPOON SAMPLE

AG = AUGER CUTTINGS

SPT = STANDARD PENETRATION TEST

LL = LIQUID LIMIT

PL = PLASTIC LIMIT

PI = PLASTIC INDEX

UU = TRIAXIAL COMPRESSION

NOTES:

SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-51	1	0	0.6													Concrete Pavement
	2	0.6	2	UD		30								1.5	1.5	Fill: Fat Clay (CH)
	3	2	4	UD		31								1.5	1.5	Fat Clay (CH)
	4	4	6	UD		28								1.5	1.5	Fat Clay (CH)
	5	6	8	UD		33								1.5	1.5	Fat Clay (CH)
	6	8	10	UD		24	99	82	24	58	92	2.5		1.5	1.5	Fat Clay (CH)

LEGEND:

UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD

SS = SPLIT SPOON SAMPLE

AG = AUGER CUTTINGS

SPT = STANDARD PENETRATION TEST

LL = LIQUID LIMIT

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NOTES:

SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	ATTERBERG LIMITS PL (%)	ATTERBERG LIMITS PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	SHEAR STRENGTH (TSF) UU TEST (CONFINING PRESSURE. TSF)	SHEAR STRENGTH (TSF) TORVANE	SHEAR STRENGTH (TSF) POCKET PENETRO METER	TYPE OF MATERIAL
B-3A	1	0	2	UD		28								1.32	1.28	Fill: Fat Clay (CH)
	2	2	4	UD		29								0.9	0.88	Fat Clay (CH)
	3	4	6	UD		30		75	23	52				0.88	0.75	Fat Clay (CH)
	4	6	8	UD		30								0.9	0.88	Fat Clay (CH)
	5	8	10	UD		31								1.5	1.5	Fat Clay (CH)
B-4A	1	0	2	UD		28								0.98	0.95	Fill: Fat Clay (CH)
	2	2	4	UD		32								0.88	0.78	Fat Clay (CH)
	3	4	6	UD		29								0.95	0.88	Fat Clay (CH)
	4	6	8	UD		28								1.38	1.32	Fat Clay (CH)
	5	8	10	UD		25		65	22	43				1.5	1.5	Fat Clay (CH)

LEGEND:

UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD

SS = SPLIT SPOON SAMPLE

AG = AUGER CUTTINGS

SPT = STANDARD PENETRATION TEST

LL = LIQUID LIMIT

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NOTES:

SUMMARY OF LABORATORY TEST RESULTS

Geotechnical Consultant's Name: Geotech Engineering and Testing

PROJECT NAME: PROPOSED WATER LINE REPLACEMENT, HUGHES ROAD AREA

COH WBS NUMBER: S-00035-0187-4

CONSULTANT PROJECT NUMBER: 14-320E

BORING NO.	SAMPLE NO.	DEPTH (FT) Top	DEPTH (FT) Bottom	TYPE	SPT	WATER CONTENT(%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL (%)	PL (%)	PI (%)	PERCENT PASSING SIEVE 200 (%)	SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST	UU TEST (CONFINING PRESSURE. TSF)	TORVANE	POCKET PENETRO METER	TYPE OF MATERIAL
B-46A	2	0	2	UD		27		74	23	51				0.5	0.46	Fill: Fat Clay (CH)
	3	2	4	UD		24								0.78	0.75	Fat Clay (CH)
	4	4	6	UD		22								1	0.98	Fat Clay (CH)
	5	6	8	UD		21								1.32	1.25	Fat Clay (CH)
	6	8	10	UD		23		76	23	53				0.88	0.85	Fat Clay (CH)
	8	10	12	UD		24								1.5	1.36	Fat Clay (CH)
	9	12	14	UD		22								1.12	1.11	Fat Clay (CH)
	10	14	16	UD		27								0.88	0.75	Fat Clay (CH)
	11	16	18	UD		27								1.32	1.25	Fat Clay (CH)
	12	18	20	UD		28								1.12	1.11	Fat Clay (CH)
	13	20	21	UD		26								0.88	0.75	Fat Clay (CH)

LEGEND:

UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD

SS = SPLIT SPOON SAMPLE

AG = AUGER CUTTINGS

SPT = STANDARD PENETRATION TEST

LL = LIQUID LIMIT

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NOTES:

APPENDIX B

Piezometer Installation and Abandonment Report

STATE OF TEXAS WELL REPORT for Tracking #371789

Owner:	CITY OF HOUSTON	Owner Well #:	PZ-1
Address:	HUGHES ROAD PROJECT HOUSTON , TX	Grid #:	65-31-1
Well Location:	NORTHWEST CORNER OF SAGECANYON DRIVE AND SAGEORCHARD DR. INTERSECTION HOUSTON , TX	Latitude:	29° 35' 16" N
Well County:	Harris	Longitude:	095° 13' 54" W
Elevation:	No Data	GPS Brand Used:	GOOGLE EARTH
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 7/11/2014
Completed: 7/11/2014

Diameter of Hole: Diameter: **6 in From Surface To 16 ft**

Drilling Method: **Bored**

Borehole Completion: **Straight Wall**

Annular Seal Data:
1st Interval: **From 16 ft to 4 ft with 5 SAND (#sacks and material)**
2nd Interval: **From 4 ft to 2 ft with 1 BENT.CHIPS (#sacks and material)**
3rd Interval: **From 2 ft to 0 ft with 1 CEMENT (#sacks and material)**
Method Used: **HANDMIX**
Cemented By: **MEDI**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **BENTONITE CHIPS 4-2**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**MATHERS ENVIRONMENTAL DRILLING INC.** **12243 B. FM 529** **HOUSTON , TX 77041**
Driller License Number:	**54933**
Licensed Well Driller Signature:	**SHANNON MATHERS**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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

Please include the report's Tracking number (Tracking #371789) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL	CASING, BLANK PIPE & WELL SCREEN DATA
From (ft) To (ft) Description	Dia. New/Used Type Setting From/To
0-2 FILL FAT CLAY	**2" NEW PLASTIC SCREEN SLOT 0.010 16'-6' SCH.40**
2-16 FAT CLAY	**2" NEW PLASTIC BLANK 6'-0 SCH.40**

STATE OF TEXAS WELL REPORT for Tracking #371790

Owner:	CITY OF HOUSTON	Owner Well #:	PZ-2
Address:	HUGHES ROAD PROJECT HOUSTON , TX	Grid #:	65-31-1
Well Location:	NORTHEAST CORNER OF HALL RD. AND SAGEBERRY DRIVE HOUSTON , TX	Latitude:	29° 35' 15" N
Well County:	Harris	Longitude:	095° 13' 36" W
Elevation:	No Data	GPS Brand Used:	GOOGLE EARTH
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date:	Started: 7/11/2014 Completed: 7/11/2014
Diameter of Hole:	Diameter: **6 in From Surface To 16 ft**
Drilling Method:	**Bored**
Borehole Completion:	**Straight Wall**
Annular Seal Data:	1st Interval: **From 16 ft to 4 ft with 5 SAND (#sacks and material)** 2nd Interval: **From 4 ft to 2 ft with 1 BENT.CHIPS (#sacks and material)** 3rd Interval: **From 2 ft to 0 ft with 1 CEMENT (#sacks and material)** Method Used: **HANDMIX** Cemented By: **MEDI** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**BENTONITE CHIPS 4-2**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: No Data Depth of Strata: No Data Chemical Analysis Made: No Data Did the driller knowingly penetrate any strata which contained undesirable constituents: No Data
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	MATHERS ENVIRONMENTAL DRILLING INC. 12243 B. FM 529 HOUSTON , TX 77041
Driller License Number:	54933
Licensed Well Driller Signature:	SHANNON MATHERS
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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

Please include the report's Tracking number (Tracking #371790) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL	CASING. BLANK PIPE & WELL SCREEN DATA
From (ft) To (ft) Description **0-2 FILL FAT CLAY** **2-16 FAT CLAY**	Dia. New/Used Type Setting From/To **2" NEW PLASTIC SCREEN SLOT 0.010 16'-6' SCH.40** **2" NEW PLASTIC BLANK 6'-0 SCH.40**

STATE OF TEXAS PLUGGING REPORT for Tracking #96325

Owner:	CITY OF HOUSTON	Owner Well #:	PZ-1
Address:	HUGHES ROAD PROJECT HOUSTON , TX	Grid #:	65-31-1
Well Location:	NORTHWEST CORNER OF SAGECANYON DRIVE AND SAGEORCHARD DR. INTERSECTION HOUSTON , TX	Latitude:	29° 35' 16" N
Well County:	Harris	Longitude:	095° 13' 54" W
		GPS Brand Used:	GOOGLE EARTH
Well Type:	Monitor		

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	SHANNON MATHERS
Driller's License Number of Original Well Driller:	54933
Date Well Drilled:	7/11/2014
Well Report Tracking Number:	371790
Diameter of Borehole:	6" inches
Total Depth of Borehole:	16' feet

Date Well Plugged:	8/14/2014
Person Actually Performing Plugging Operation:	SHANNON MATHERS
License Number of Plugging Operator:	54933
Plugging Method:	Tremmie pipe cement from bottom to top.
Plugging Variance #:	No Data
Casing Left Data:	

	1st Interval: 0 inches diameter, (No Data) ft to (No Data) ft 2nd Interval: No Data 3rd Interval: No Data
Cement/Bentonite Plugs Placed in Well:	1st Interval: From 16 ft to 0 ft; Sack(s)/type of cement used: 3 CEMENT 2nd Interval: No Data 3rd Interval: No Data 4th Interval: No Data 5th Interval: No Data

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	MATHERS ENVIRONMENTAL DRILLING INC. 12243 B. FM 529 HOUSTON , TX 77041
Plug Installer License Number:	54933
Licensed Plug Installer Signature:	SHANNON MATHERS
Registered Plug Installer Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Plugging Method Comments:	No Data

Please include the plugging report's tracking number (Tracking #96325) on your written request.

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

STATE OF TEXAS PLUGGING REPORT for Tracking #96324

Owner:	CITY OF HOUSTON	Owner Well #:	PZ-2
Address:	HUGHES ROAD PROJECT HOUSTON , TX	Grid #:	65-31-1
Well Location:	NORTHEAST CORNER OF HALL RD. AND SAGEBERRY DRIVE HOUSTON , TX	Latitude:	29° 35' 15" N
Well County:	Harris	Longitude:	095° 13' 36" W
		GPS Brand Used:	GOOGLE EARTH

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	SHANNON MATHERS
Driller's License Number of Original Well Driller:	54933
Date Well Drilled:	7/11/2014
Well Report Tracking Number:	371790
Diameter of Borehole:	6" inches
Total Depth of Borehole:	16' feet

Date Well Plugged:	8/14/2014
Person Actually Performing Plugging Operation:	SHANNON MATHERS
License Number of Plugging Operator:	54933
Plugging Method:	Tremmie pipe cement from bottom to top.
Plugging Variance #:	No Data
Casing Left Data:	1st Interval: 0 inches diameter, (No Data) ft to (No Data) ft 2nd Interval: No Data 3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well:	1st Interval: From 16 ft to 0 ft; Sack(s)/type of cement used: 3 CEMENT 2nd Interval: No Data 3rd Interval: No Data 4th Interval: No Data 5th Interval: No Data
Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	MATHERS ENVIRONMENTAL DRILLING INC. 12243 B. FM 529 HOUSTON , TX 77041
Plug Installer License Number:	54933
Licensed Plug Installer Signature:	SHANNON MATHERS
Registered Plug Installer Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Plugging Method Comments:	No Data

Please include the plugging report's tracking number (Tracking #96324) on your written request.

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

APPENDIX C

Project Alignments Pictures

PROJECT PICTURES
Project No. 14-320E

P-1 (A Picture of Project Alignment along Sagetrail Drive)

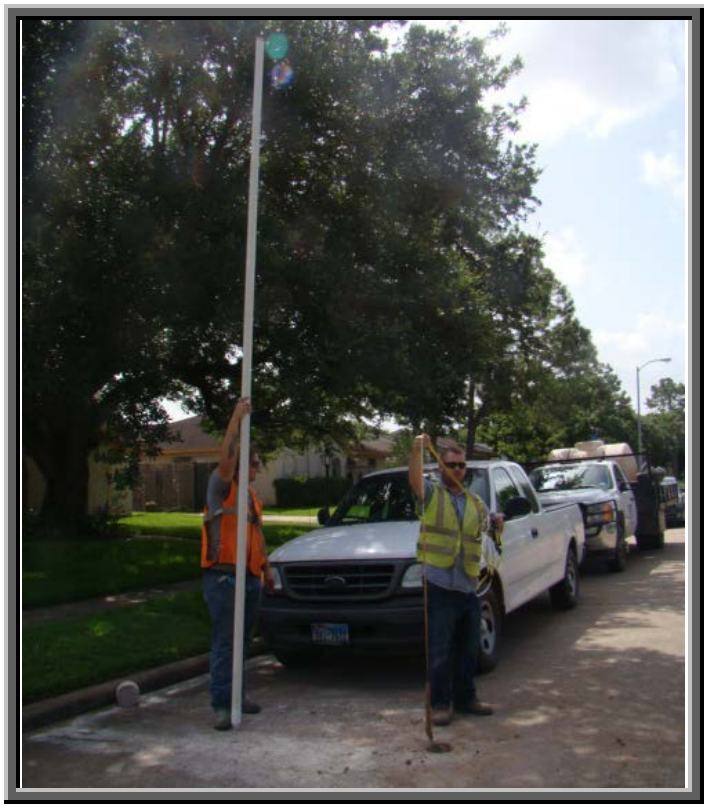
P-2 (A Picture of Drilling Operation along Sagecanyon Drive)

PROJECT PICTURES
Project No. 14-320E

P-3 (A Picture of Grouting using Tremie Method along at Sageberry Drive)

P-4 (A Picture of Grouting using Tremie Method along at Sageberry Drive)

PROJECT PICTURES
Project No. 14-320E



P-5 (A Picture of Piezometer Installation at Sagecanyon Drive)

P-6 (A Picture of Piezometer Installation at Sagecanyon Drive)

APPENDIX D

OSHA Soil Classifications

OSHA SOIL CLASSIFICATIONS

General

Occupational Safety and Health Administration (OSHA) has required a trench protective system for trenches deeper than five-ft. Trenches that are deeper than five-ft, should be shored, sheeted, braced or laid back to a stable slope, or some other appropriate means of protection should be provided where workers might be exposed to moving ground or caving. OSHA developed a soil classification system to be used as a guideline in determining protective requirements for trench excavations.

OSHA classification system categorizes the soil and rock in four types based on shear strength and stability. These classifications are summarized in the following report sections.

Stable Rock

Means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type A Soil

Means cohesive soils with an unconfined compressive strength of 1.5-ton per square foot (tsf) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam, silty clay loam, sandy clay loam, caliche and hardpan. No soil is Type A if:

- The soil is fissured; or
- The soil is subject to vibration from heavy traffic, pile driving or similar effects; or
- The soil has been previously disturbed; or
- The soil is part of a slope, layered system where the layers dip into the excavation on a slope of 4(h): 1(v) or greater; or
- The material is subject to other factors that would require it to be classified as a less stable material.

Type B Soil

- 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, silt loam, sandy loam, and in some case, silty clay loam and sandy clay loam; or
- Previously disturbed soils except those which would otherwise be classified as Type C soil; or
- 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 4(h): 1(v), but only if the material would otherwise be classified as Type B.

Type C Soil

- Cohesive soil with an unconfined compressive strength of 0.5 tsf or less; or
- Granular soils 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
- Materials in a sloped, layered system where the layers dip into the excavation on a slope 4 (h) : 1(v) or steeper.

Under the assumption that appropriate groundwater control measures are carried out, and the groundwater table, if present, is lowered and maintained at least 3 feet below the excavation depths, the stable cohesive soils (CL) & (CH), with unconfined compressive strength greater than 0.5 tsf, are classified as OSHA soil Type "B". The granular soils, which are less stable, are classified as OSHA soil Type "C".

Based on our geotechnical exploration and laboratory test results details of soil classifications at each boring are summarized below:

OSHA SOIL TYPE

Boring No.	Depth Range (1), ft	Soil Type	OSHA Soil Classification
B-1, B-4 through B-10, B-13 through B-28, B-30, B-32, B-33, B-36 through B-38, B-40 through B-42, B-44, B-45, B-48, B-50 and B-51	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 10	Fat Clay (CH)	B
B-2, B-34 and B-47	0.6 – 2	Fill: Fat Clay (CH)	C
	2 – 10	Fat Clay (CH)	B
B-3	0.75 – 2	Fill: Fat Clay (CH)	B
	2 – 10	Fat Clay (CH)	B

Boring No.	Depth Range [1], ft	Soil Type	OSHA Soil Classification
B-3A and B-4A	0 – 2	Fill: Fat Clay (CH)	B
	2 – 10	Fat Clay (CH)	B
B-11 and B-12	0.6 – 2	Fill: Lean Clay (CL)	B
	2 – 10	Fat Clay (CH)	B
B-29	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 16	Fat Clay (CH)	B
B-31	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 4	Fat Clay (CH)	C
	4 – 6	Fat Clay (CH)	B
	6 – 10	Fat Clay (CH)	B
B-35	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 4	Fat Clay (CH)	C
	4 – 10	Fat Clay (CH)	B
B-39	0.6 – 2	Fill: Fat Clay (CH)	C
	2 – 15	Fat Clay (CH)	B
	15 – 16	Fat Clay (CH)	C
B-43	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 15	Fat Clay (CH)	B
	15 – 16	Fat Clay (CH)	C
B-46	0.6 – 2	Fill: Fat Clay (CH)	C
	2 – 21	Fat Clay (CH)	B
B-46A	0 – 2	Fill: Fat Clay (CH)	C
	2 – 21	Fat Clay (CH)	B
B-49	0.6 – 2	Fill: Fat Clay (CH)	B
	2 – 15	Fat Clay (CH)	B
	15 – 17	Fat Clay (CH)	C

Note: 1. Refer to each boring log for soil stratigraphy