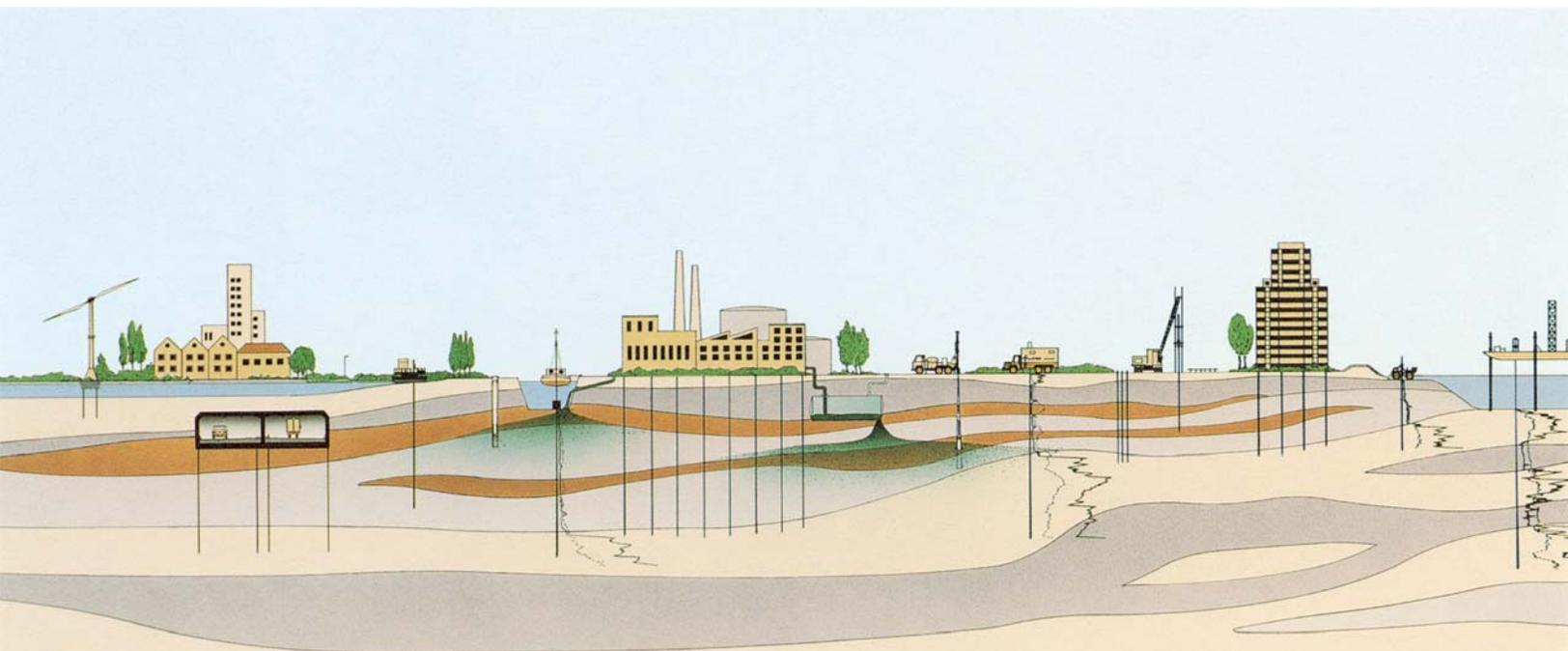


**GEOTECHNICAL REPORT  
HCC CENTRAL CAMPUS IMPROVEMENTS  
HOUSTON COMMUNITY COLLEGE  
HOUSTON, TEXAS**

LLEWELYN-DAVIES SAHNI  
HOUSTON, TEXAS





Report No. 04.12100054  
November 7, 2012

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**LLEWELYN-DAVIES SAHNI**  
5120 Woodway Drive, Suite 8010  
Houston, Texas 77055

Attention: Mr. Ranjan Roy

**Geotechnical Report**  
**HCC Central Campus Improvements**  
**Houston Community College**  
**Houston, Texas**

**Introduction**

Fugro Consultants, Inc. (Fugro) is pleased to present this report of our geotechnical study for the above-referenced project. Mr. Ranjan Roy with Llewelyn-Davies Sahni (LDS) requested our services via e-mail addressed to Mr. Scott A. Marr, P.E. LEED AP of Fugro on March 11, 2010. Our services were authorized by The Houston Community College System (HCC) on May 3, 2011 via issuance of executed contract document *AIA Document G602-1993*.

**Project Description.** We understand that HCC plans to construct site improvements to their Central Campus located at 1300 Holman Street in Houston, Texas. A *Vicinity Map* of the site location is presented on [Plate 1](#).

We understand that the project architect is LDS and the project civil engineer is ESPA Corp (ESPA). Based on information provided to us at the time of our proposal, we understand that site improvements would include the construction of paved parking areas, roadway improvements and architectural and landscaping improvements. The project was put on indefinite hold awaiting access to drill along La Branch Street. Mr. Roy contacted Fugro on October 19, 2012 and requested a report of our investigation including subgrade preparation recommendations for the proposed concrete pavers.

**Purpose and Scope.** The purposes of our geotechnical study were to: 1) explore and evaluate the general subsurface soil and depth-to-water conditions, 2) describe encountered subsurface conditions and 3) provide subgrade preparation recommendations for the proposed concrete pavers. The scope of this study included the following:

- Drilling 8 soil borings to explore subsurface conditions and obtain samples for geotechnical laboratory testing;



- Performing laboratory tests on selected soil samples to evaluate the engineering properties of the subsurface soils;
- Analyzing the field and laboratory data; and
- Preparing this report summarizing our findings.

Environmental assessments, compliance with State and Federal Regulatory requirements, and/or environmental analyses including those associated with mold, fungi, and other biologic agents were beyond the scope of this study. A geologic fault study was outside the scope of our services.

**Applicability of Report.** We have prepared this report exclusively for The Houston Community College System as described herein. We have conducted this study using the standard level of care and diligence normally practiced by recognized engineering firms now performing similar services under similar circumstances. We intend for this report, including all illustrations, to be used in its entirety. Furthermore, this report should **not** be construed to represent a warranty of subsurface conditions, nor should this report be used, whether in whole or part, as a stand-alone construction specification document. Site conditions may have changed since our field exploration performed in 2010. Fugro makes no claim or representation concerning any activity or condition falling outside the specified purpose to which this report is directed.

### **Field Exploration**

Our field activities related to geotechnical soil borings are discussed in this section. We have included discussions relating to drilling and sampling methods, depth-to-water measurements, and borehole completion.

**General.** We explored the subsurface soil condition by drilling 8 soil borings, designated Borings B-1 through B-5 and B-9 through B-11, with our truck-mounted drilling equipment on May 9, 2010 and May 22, 2010. ESPA selected the boring locations on existing concrete pavements at the project site shown on the *Geotechnical Boring Layout*, dated March 11, 2010. At the time of our exploration, we were not granted access to drill Borings B-6 through B-8 along La Branch Street. Prior to drilling, Fugro marked the approximate locations of the borings at the project site and coordinated concrete coring of the existing concrete pavements. All the borings except Borings B-4 and B-5 were drilled to a depth of 10 feet below existing grade. While drilling Borings B-4 and B-5, we encountered unknown concrete obstructions about 4 feet and 6 feet below existing grade, respectively. Upon completion of drilling, we patched the concrete cores with quick drying cement. The approximate boring locations are shown on the *Plan of Borings* presented on [Plate 2](#).

**Drilling and Sampling Methods.** The borings were drilled using dry-auger techniques. Soil samples were generally taken at 2-foot intervals to a depth of about 10 feet below existing grade (shallower depths of 4 feet and 6 feet below existing grade for Borings B-4 and B-5, respectively). Detailed descriptions of the soils encountered at Borings B-1 through B-5 and B-9 through B-11

are presented on the boring logs on [Plates 3](#) through [10](#). A key identifying the terms and symbols on the boring logs is presented on [Plates 11a](#) and [11b](#).

Undisturbed samples of cohesive soils were generally obtained by hydraulically pushing a 3-inch diameter, thin-walled tube a distance of about 24 inches. Our field procedure for sampling cohesive soil was conducted in general accordance with ASTM D1587, *Standard Practice for Thin-Walled Tube Sampling of Soils*. The soil samples were extruded in the field and visually classified by our field technician. We obtained field estimates of the undrained shear strength of the recovered samples using a calibrated hand-held penetrometer. The field estimates were modified for stiff to hard, over-consolidated, *natural*, cohesive soils, as described on [Plate 11b](#). Portions of each recovered soil sample were placed into appropriate containers for transportation to our laboratory for additional geotechnical testing.

**Depth-to-Water Measurements.** Depth-to-water observations were performed in the open boreholes in an effort to identify the depth-to-water at the site. Discussion of our interpretation of the depth-to-water conditions is presented later in the *General Site Conditions* section of this report.

**Borehole Completion.** After completing the field activities, borings was backfilled with soil cuttings and bentonite chips, *i.e.* holeplug. The soil cuttings and bentonite chips were placed in the boreholes until relatively level with the bottom of pavement and patched pavement with quick drying cement.

### Laboratory Testing

We directed our laboratory program toward classifying the foundation soils, identifying fill soils, and evaluating the undrained shear strength of the cohesive subsurface soils. Our laboratory testing also included analytical testing for corrosive potential of the subsurface soils. Our laboratory tests were performed in general accordance with the appropriate standards as tabulated at the end of this section.

**Classification Tests.** The classification tests included tests for natural moisture content, liquid and plastic limits (collectively termed Atterberg limits), and material finer than the No. 200 sieve (percent fines). These tests aid in classifying the soils and are used to correlate the results of other tests performed on samples taken from different borings and/or different depths. The results of the classification tests are recorded on the boring logs on [Plates 3](#) through [10](#).

**Undrained Shear Strength Tests.** The undrained shear strength from selected undisturbed samples of cohesive soils was measured by performing unconfined compression (UC) tests. The natural moisture content and dry unit weights were determined as routine parts of the compression tests. The results of the laboratory shear strength test, along with the field estimates of shear strength, are presented on the boring logs.

**Corrosion Potential Tests.** The corrosion potential of the near-surface soils was evaluated using a series of analytical laboratory tests including pH, sulfate ion concentration, chloride ion

concentration and electrical resistivity. The results of the analytical laboratory tests are presented in [Appendix A](#) of this report.

**Summary of Laboratory Testing.** [Table 1](#) lists the type and number of laboratory tests performed for this study as well as the applicable test standard.

**Table 1 – Laboratory Test Quantities and Testing Standards**

<i>Laboratory Test</i>	<i>Quantity</i>	<i>Testing Standard</i>
Moisture Content	19	ASTM D2216
Atterberg Limits	7	ASTM D4318
Dry Unit Weight	5	ASTM D2166
Percent Passing No. 200 Sieve	1	ASTM D1140
Unconfined Compression	5	ASTM D2166
pH	3	ASTM G51
Sulfate Ion Concentration	3	ASTM D516
Chloride Ion Concentration	3	ASTM D512

### General Site Conditions

The interpreted site and subsurface conditions based on our field exploration, laboratory testing, and our experience are discussed in this section.

**Site Location and Description.** The project site is located at the HCC Central Campus in Downtown Houston. It is enclosed by Holman Street, San Jacinto Street, Crawford Street and Alabama Street. The site is developed with existing academic buildings, parking garages, and concrete paved parking lots. A layout of the site location is presented on the *Plan of Borings* on [Plate 2](#).

**Subsurface Conditions.** The subsurface conditions at the site consist primarily of cohesive fill soils overlying *natural* cohesive soils.

In some areas, undocumented fill soils were generally encountered beneath existing 5-inch to 1-foot thick asphalt and concrete paving to a depth of 1.5 feet to 6 feet below existing grade. The fill soils consist of highly plastic clays with a liquid limit 46, a plastic limit 10 and corresponding plasticity index of 36. Field estimates and laboratory tests indicates the undrained shear strength of the cohesive fill soils range from 2,000 psf (stiff) to greater than 4,500 psf (hard).

**Natural** cohesive soils were generally encountered beneath the undocumented fill soils or from beneath the existing paving and extend to a depth of 10 feet below existing grade, the maximum depth drilled for this study. The natural cohesive soils consist of highly plastic clays with liquid

limits ranging from 40 to 60, plastic limits ranging from 10 to 13, and corresponding plasticity indices ranging from 29 to 47. Field estimates and laboratory tests indicates the undrained shear strength of the natural cohesive soils range from about 1,200 psf (stiff) to about 2,800 psf (very stiff). Shell fragments, ferrous nodules and calcareous nodules are observed in the natural cohesive soils.

Additional information about the soils encountered in the borings drilled for our study can be found on the boring logs on [Plates 3 through 10](#).

**Depth-to-Water Conditions.** The borings were drilled using only dry-auger drilling technique in an effort to identify the depth-to-water condition at the site. Free water was not encountered in the borings to a depth of 10 feet. Standing water was observed at a depth of 4 feet in Boring B-4.

Please note that short-term depth-to-water observations recorded in open boreholes should **not** be considered to represent a long-term condition, especially in high plastic cohesive soils. The time associated with short-term observations may not be sufficient for the conditions in the open borehole to reach equilibrium. More accurate determinations of groundwater levels are usually made using long-term standpipe piezometer readings. It should be noted that groundwater levels will fluctuate with seasonal variations in rainfall, water level, and surface runoff especially during extended periods of heavy rainfall or dry weather. For design purposes, the groundwater level should be considered at the ground surface.

**Variations in Subsurface Conditions.** Our interpretations of soil conditions, as described in this report, are based on data obtained from our visual observations, sample borings, laboratory tests, and our experience. Although we have allowed for minor variations in the subsurface conditions, our recommendations may **not** be appropriate for subsurface conditions other than those reported herein. It is possible that some undisclosed variations in soil or groundwater conditions might occur outside the boring locations, especially with respect to the presence, depth, consistency, and extent of fill material at the site location. As mentioned earlier, site conditions may have changed since our field exploration performed in 2010. We recommend careful observations during any construction to verify our interpretations. Should variations from our interpretations be found, we recommend that we be notified and authorized to evaluate what, if any, revisions should be made to our recommendations.

## Construction Considerations

Recommendation regarding subgrade preparation, shallow open-cut excavations, structural clay fill, lime-stabilized clay fill and construction monitoring are included in the following paragraphs.

**Subgrade Preparation.** As mentioned earlier, we understand that the proposed site improvement will only consist of removal of existing pavements and placement of proposed concrete pavers for this project. Therefore, we recommend that subgrade preparation include clearing and stripping of all significant vegetation, organic materials, debris, and other deleterious materials. Areas of exposed subgrade that are observed to be soft, wet, weak, or contain deleterious materials should be over-excavated to expose competent soils. Over-excavated areas should be backfilled with properly placed and compacted structural clay fill. Recommendations for structural clay fill are discussed later in this report.

After removing deleterious materials and stripping, the exposed subgrade should be proofrolled with a fully loaded dump truck or other heavy (20-ton), rubber-tired vehicle (where practical) and observed by the Geotechnical Engineer-of-Record or their qualified representative to evaluate the condition of the subgrade. We recommend scheduling these activities during a relatively dry period. We do not recommend that subgrade preparation activities begin immediately after or during a significant rain event. It may be necessary to wait for the site to dry prior to starting subgrade preparation activities depending on the effectiveness of onsite drainage.

Based on our study, we encountered some areas with more than 3-foot thick layers of undocumented fill soils beneath existing pavements. Typically, we do **not** recommend placing pavements or other structures on substantial undocumented fill areas because distress may result from differential settlements of subgrade fill soils. Thus, we recommend maintenance of the proposed concrete pavers be performed on a routine basis.

**Shallow Open-Cut Excavation.** Excavation safety systems should be in accordance with current federal Occupational Safety and Health Administration (OSHA) standards for excavations. The OSHA requirements do not generally require shallow excavations to depths of 4 feet or less to be sloped back or braced. However, if sloughing and caving is noticed, we recommend that slopes be cut back to a stable slope. Excavations deeper than 4 feet are required to be sloped back or braced, according to OSHA regulations.

Based on our interpretation of the regulations and anticipated soil conditions, **natural** cohesive soils would be classified as Type B soils and the cohesive fill would be Type C soils. Sides of temporary vertical excavations less than 4 feet deep may stay open for short periods of time. However, if sides of slopes begin to slough, the sides should be either braced or sloped back to a stable condition. Excavations deeper than about 4 feet should be either braced or sloped back no steeper than 1-horizontal to 1-vertical for Type B soils and 1.5-horizontal to 1-vertical for Type C soils. Flatter slopes or bracing should be used in either case if sloughing or raveling is observed. We recommend that positive surface drainage away from all excavations should be established to

prevent surface runoff from either flooding excavations or ponding around completed foundations. Any seepage into excavations is expected to be minor. Pumps and sumps should be available onsite to handle seepage and water from surface runoff.

**Structural Clay Fill.** Structural clay fill may be used for subgrade material, or to replace unsuitable soils. We recommend using low plasticity cohesive soils for structural clay select fill. Structural clay fill should have a liquid limit of less than 40, a plasticity index between 8 and 20, and at least 60 percent of the material finer than the No. 200 Sieve. Structural clay select fill should be free of deleterious matter and should have an effective clod diameter less than 3 inches. We do **not** recommend mixing sand with high plasticity clay to develop structural clay fill.

Structural clay fill should be placed in 6- to 8-inch-thick loose lifts and uniformly compacted to 95 percent of the maximum dry density at a moisture content of 1 percent “dry” to 3 percent “wet” of optimum as determined by ASTM D698 (Standard Proctor). Structural clay select fill should be compacted by a sheepsfoot or padfoot type roller, or by alternative methods that provide a “kneading” compaction equivalent to the sheepsfoot or padfoot roller. We recommend using hand-operated compaction equipment and 4-inch thick loose lifts adjacent to foundations and in confined areas.

If wet weather or extended dry periods deteriorate the exposed surface whereby a good bond cannot be formed between successive lifts, the Contractor should prepare the surface as necessary. This preparation may include removing or scarifying the top couple of inches of the underlying material before placing the next lift.

Some of the onsite cohesive soils do not meet the plasticity requirement for structural clay fill. As such, we recommend that these cohesive soils be tested to verify the plasticity requirement prior to use or alternatively the soils may be lime-stabilized.

**Lime-Stabilized Clay Fill.** Lime-stabilization may be used to modify potential clay fill materials. Laboratory tests should be conducted at the time of construction to determine the optimum lime content. The optimum lime content is the amount of lime necessary to achieve a pH of 12.4 (which represents lime fixation), while trying to achieve a plasticity (PI) of less than 20. For estimation purposes, about 6 to 8 percent lime, by dry weight, may be required to stabilize the onsite high plasticity clay soils. Organics, chemical fertilizers, and some clay minerals can modify the amount of lime necessary for lime fixation. We recommend that a lime series be performed using the specific soil samples and proposed lime additive.

Lime-stabilization should be done in accordance with the Lime Association recommendations. Key items for lime-stabilizing the clay soils include placing the proper percentage of lime, thoroughly mixing the lime into the clay soils, bringing the stabilized soil to the proper moisture content, allowing the stabilized soil to cure for at least 48 hours, adjusting the moisture content from 1 percent “dry” to 3 percent “wet” of optimum moisture content, pulverizing the soils again until the lime is thoroughly blended, then placing the stabilized soil in accordance with the

recommendations discussed herein. Lime-stabilized clay fill should be placed in 6- to 8-inch-thick loose lifts and uniformly compacted to 95 percent of the maximum dry density as determined by ASTM D698 (Standard Proctor).

The moisture-density relationship should be established based on a material sample obtained on-site after stabilization with lime. A combination of sheepsfoot or padfoot rollers and pneumatic rollers is recommended to compact the lime-stabilized clay fill.

**Construction Monitoring.** We recommend that the Geotechnical Engineer-of-Record or their qualified representative be present onsite during excavation to evaluate the suitability of subgrade soils. Onsite observations may also aid in recognizing and reconciling other unanticipated soil or groundwater conditions and endeavor to verify that design recommendations are appropriate and properly implemented during construction. We recommend that we be retained during subgrade preparation and construction phases to provide materials testing and construction surveillance to: (1) observe compliance with specifications and recommendations; (2) observe subsurface conditions during construction; (3) perform quality control tests.

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The following illustrations are attached and complete this report:

	<u>Plate</u>
Vicinity Map .....	1
Plan of Borings .....	2
Logs of Borings.....	3 to 10
Terms and Symbols Used on Boring Logs.....	11a and 11b

**Appendix A**

Analytical Laboratory Test Results .....	(3 pages)
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**Closing**

We appreciate the opportunity to be of continued service to The Houston Community College System. Please call us if you have any questions or comments concerning this report or when we may be of further assistance.

Sincerely,  
**FUGRO CONSULTANTS, INC.**  
TBPE Firm Registration No. F-299

*Julia P. Clarke*  
7 NOV 2012

Julia P. Clarke, P.E.  
Project Professional



*Scott A. Marr*  
7 NOV 2012

Scott A. Marr, P.E., LEED AP  
Project Manager



Copies Submitted: Electronic PDF (1); Bound (4)

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## ILLUSTRATIONS







DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH							
			SURFACE EL.: Not Available		UNIT DRY WT. POF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT						
STRATUM DESCRIPTION																	
			(5") CONCRETE	0.4													
			FILL: CLAY, stiff, tan and gray	1.5													
			CLAY, stiff, gray and tan, with calcareous nodules														
			- with ferrous nodules below 4'														
			- very calcareous below 6'														
5					98		25	60	13	47							
							15										
10				10.0													
15																	
20																	
25																	
<b>NOTES:</b> 1. Free water was not encountered during drilling. 2. Terms and symbols defined on Plates 11a and 11b.					DATE: May 9, 2010 TOTAL DEPTH: 10' CAVED DEPTH: Not Applicable DRY AUGER: Surface to 10' WET ROTARY: Not Applicable BACKFILL: Holeplug and Drying Cement LOGGER: T. Mireles												

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-1**  
**HCC CENTRAL CAMPUS IMPROVEMENTS**  
**HOUSTON COMMUNITY COLLEGE**  
**HOUSTON, TEXAS**





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available	STRATUM DEPTH, FT	CLASSIFICATION						SHEAR STRENGTH							
			SURFACE EL.: Not Available		UNIT DRY WT. POF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT							
STRATUM DESCRIPTION																		
			(5") CONCRETE	0.4														
			FILL: CLAY, tan and gray	1.5	102		22	40	11	29								
			CLAY, stiff, gray - gray and tan, 2' to 6'				24											
			- with calcareous and ferrous nodules below 4'															
			- tan and gray below 6'				22											
5																		
10				10.0														
15																		
20																		
25																		
<b>NOTES:</b> 1. Free water was not encountered during drilling. 2. Terms and symbols defined on Plates 11a and 11b.					DATE: May 9, 2010 TOTAL DEPTH: 10' CAVED DEPTH: Not Applicable DRY AUGER: Surface to 10' WET ROTARY: Not Applicable BACKFILL: Holeplug and Drying Cement LOGGER: T. Mireles													

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-2**  
**HCC CENTRAL CAMPUS IMPROVEMENTS**  
**HOUSTON COMMUNITY COLLEGE**  
**HOUSTON, TEXAS**





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH					
			SURFACE EL.: Not Available		UNIT DRY WT, POF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT				
STRATUM DESCRIPTION										0.5	1.0	1.5	2.0	2.5	
			(3") ASPHALT	0.3											
			(6") CONCRETE	0.8											
			CLAY, very stiff, brown - with roots to 4'				10								□+
5			- gray and black, with shell fragments, 4' to 8'			86	16	48	10	38					□+
			- brown and gray below 8'				18								□
10				10.0											□+
15															
20															
25															

**NOTES:**

- Free water was not encountered during drilling.
- Terms and symbols defined on Plates 11a and 11b.

DATE: May 22, 2010  
 TOTAL DEPTH: 10'  
 CAVED DEPTH: Not Applicable  
 DRY AUGER: Surface to 10'  
 WET ROTARY: Not Applicable  
 BACKFILL: Holeplug and Drying Cement  
 LOGGER: B. Burkett

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-3**  
 HCC CENTRAL CAMPUS IMPROVEMENTS  
 HOUSTON COMMUNITY COLLEGE  
 HOUSTON, TEXAS





DEPTH, FT	WATER LEVEL SYMBOL	SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH						
				SURFACE EL.: Not Available		UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT					
STRATUM DESCRIPTION																	
				(3") ASPHALT	0.3												
				(6") CONCRETE	0.8												
				FILL: CLAY, very stiff, gray and tan - with sand at 4'				17								3.5 □	
				REFUSAL AT 4'- CONCRETE	4.0			17									3.0 □
5																	
10																	
15																	
20																	
25																	

**NOTES:**

- ▽: Water First Noticed.
- Terms and symbols defined on Plates 11a and 11b.

DATE: May 22, 2010  
 TOTAL DEPTH: 4'  
 CAVED DEPTH: Not Applicable  
 DRY AUGER: Surface to 4'  
 WET ROTARY: Not Applicable  
 BACKFILL: Holeplug and Drying Cement  
 LOGGER: B. Burkett

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-4**  
 HCC CENTRAL CAMPUS IMPROVEMENTS  
 HOUSTON COMMUNITY COLLEGE  
 HOUSTON, TEXAS





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available  SURFACE EL.: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH							
					UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT						
			STRATUM DESCRIPTION														
			(3") ASPHALT	0.3													
			(6") CONCRETE	0.8													
			FILL: CLAY, very stiff to hard, brown														4.0 □
5																	4.5 □
			REFUSAL AT 6'- CONCRETE	6.0			12	46	10	36							
10																	
15																	
20																	
25																	

**NOTES:**

- Free water was not encountered during drilling.
- Terms and symbols defined on Plates 11a and 11b.

DATE: May 22, 2010  
 TOTAL DEPTH: 6'  
 CAVED DEPTH: Not Applicable  
 DRY AUGER: Surface to 6'  
 WET ROTARY: Not Applicable  
 BACKFILL: Holeplug and Drying Cement  
 LOGGER: B. Burkett

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-5**  
 HCC CENTRAL CAMPUS IMPROVEMENTS  
 HOUSTON COMMUNITY COLLEGE  
 HOUSTON, TEXAS





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH					
			SURFACE EL.: Not Available		UNIT DRY WT. POF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT				
STRATUM DESCRIPTION															
			(3") ASPHALT	0.3											
			(6") CONCRETE	0.8											
			CLAY, stiff, black		100		24	46	12	34					
5			- gray and tan below 6'				23								
10				10.0											
15															
20															
25															

**NOTES:**

- Free water was not encountered during drilling.
- Terms and symbols defined on Plates 11a and 11b.

DATE: May 22, 2010  
 TOTAL DEPTH: 10'  
 CAVED DEPTH: Not Applicable  
 DRY AUGER: Surface to 10'  
 WET ROTARY: Not Applicable  
 BACKFILL: Holeplug and Drying Cement  
 LOGGER: B. Burkett

R:1041202010 PROJECTS\0001-0099\0412-10-0054\DRAWING\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-9**  
 HCC CENTRAL CAMPUS IMPROVEMENTS  
 HOUSTON COMMUNITY COLLEGE  
 HOUSTON, TEXAS





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available  SURFACE EL.: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH							
					UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT						
			STRATUM DESCRIPTION														
			(4") ASPHALT	0.3													
			(6") SHELL BASE, possibly stabilized	0.8													
			FILL: CLAY, stiff, dark gray, with organic material	1.8													
			CLAY, stiff to very stiff, gray - gray and tan, 2' to 6' - with calcareous and ferrous nodules below 4'			20											
5			- brown and gray below 6'		114	17	48	11	37								▼
			SANDY CLAY, stiff, brown and gray	8.0													
10				10.0		22											
15																	
20																	
25																	

**NOTES:**

- Free water was not encountered during drilling.
- Terms and symbols defined on Plates 11a and 11b.

DATE: May 9, 2010  
 TOTAL DEPTH: 10'  
 CAVED DEPTH: Not Applicable  
 DRY AUGER: Surface to 10'  
 WET ROTARY: Not Applicable  
 BACKFILL: Holeplug and Drying Cement  
 LOGGER: T. Mireles

R:1041202010 PROJECTS\0001-0099\0412-10-0054\INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-10**  
 HCC CENTRAL CAMPUS IMPROVEMENTS  
 HOUSTON COMMUNITY COLLEGE  
 HOUSTON, TEXAS





DEPTH, FT	WATER LEVEL SYMBOL SAMPLES	BLOWS PER FOOT	LOCATION: See Plate 2 COORDINATES: Not Available  SURFACE EL.: Not Available	STRATUM DEPTH, FT	CLASSIFICATION					SHEAR STRENGTH							
					UNIT DRY WT. POF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	KIPS PER SQ FT						
			STRATUM DESCRIPTION														
			(4") CONCRETE over (3") SAND over (5") CONCRETE	1.0													
			CLAY, brown	2.0													
			SAND, gray, fine-grained	3.0													
			CLAY, stiff to very stiff, black	4.0													
5				5.0			21										
				6.0			18										
			- gray and tan below 6'	7.0													
				8.0													
				9.0													
				10.0	102		18	47	11	36							
				11.0													
				12.0													
				13.0													
				14.0													
				15.0													
				16.0													
				17.0													
				18.0													
				19.0													
				20.0													
				21.0													
				22.0													
				23.0													
				24.0													
				25.0													
<b>NOTES:</b> 1. Free water was not encountered during drilling. 2. Terms and symbols defined on Plates 11a and 11b.					DATE: May 22, 2010 TOTAL DEPTH: 10' CAVED DEPTH: Not Applicable DRY AUGER: Surface to 10' WET ROTARY: Not Applicable BACKFILL: Holeplug and Drying Cement LOGGER: B. Burkett												

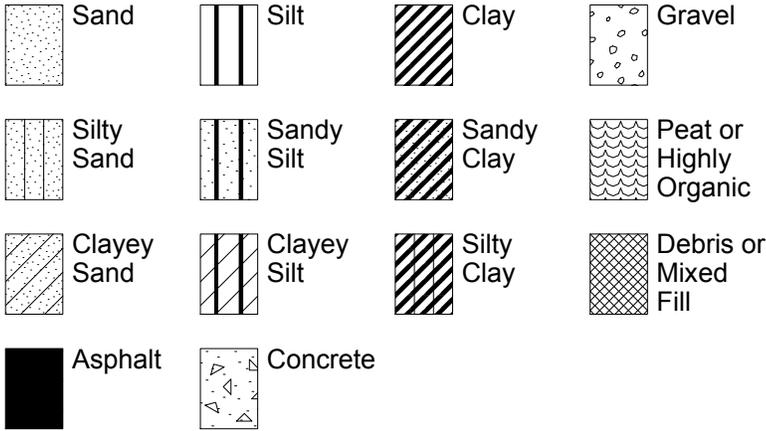
R:1041202010 PROJECTS\0001-0099\0412-10-0054\INDUSTRIAL\04.12100054.GPJ FUGRO\_SO (LAB DATA)\_INDUSTRIAL GROUP 11/7/2012

**LOG OF BORING NO. B-11**  
**HCC CENTRAL CAMPUS IMPROVEMENTS**  
**HOUSTON COMMUNITY COLLEGE**  
**HOUSTON, TEXAS**

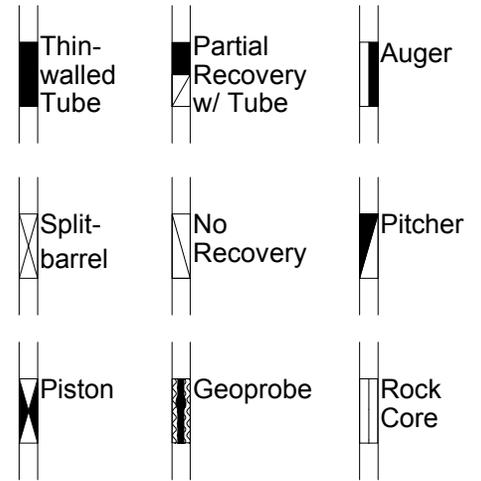




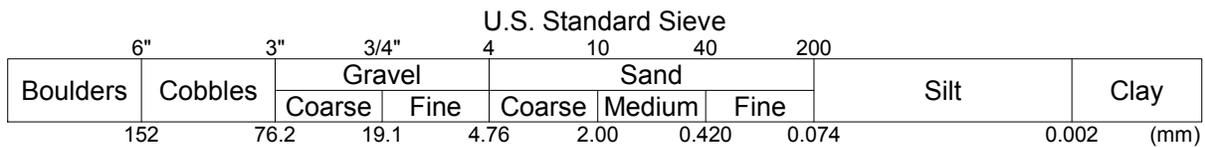
**SOIL TYPES**



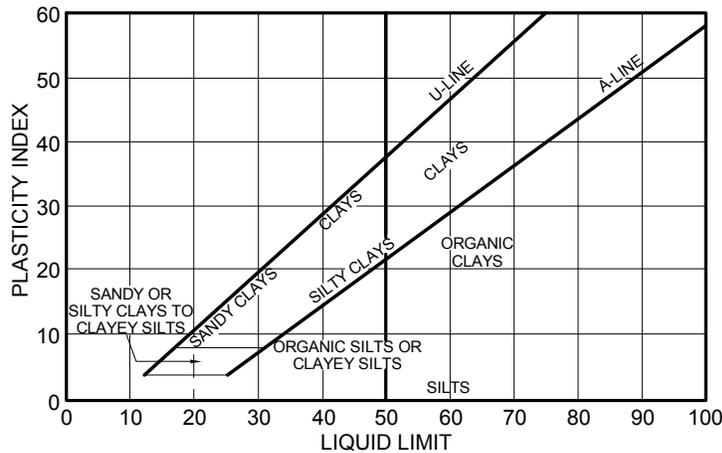
**SAMPLER TYPES**



**SOIL GRAIN SIZE**



**PLASTICITY CHART**



**SOIL STRUCTURE**

- Slickensided ..... Having planes of weakness that appear slick and glossy.
- Fissured ..... Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
- Pocket ..... Inclusion of material of different texture that is smaller than the diameter of the sample.
- Parting ..... Inclusion less than 1/8 inch thick extending through the sample.
- Seam ..... Inclusion 1/8 inch to 3 inches thick extending through the sample.
- Layer ..... Inclusion greater than 3 inches thick extending through the sample.
- Laminated ..... Soil sample composed of alternating partings or seams of different soil type.
- Interlayered ..... Soil sample composed of alternating layers of different soil type.
- Intermixed ..... Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
- Calcareous ..... Having appreciable quantities of carbonate.
- Carbonate ..... Having more than 50% carbonate content.

**TERMS AND SYMBOLS USED ON BORING LOGS**

**SOIL CLASSIFICATION (1 of 2)**





**STANDARD PENETRATION TEST (SPT)**

A 2-in.-OD, 1-3/8-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

**SPLIT-BARREL SAMPLER DRIVING RECORD**

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

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

**DENSITY OF GRANULAR SOILS**

Descriptive Term	*Relative Density, %	**Blows Per Foot (SPT)
Very Loose	< 15	0 to 4
Loose	15 to 35	5 to 10
Medium Dense	35 to 65	11 to 30
Dense	65 to 85	31 to 50
Very Dense	> 85	> 50

\*Estimated from sampler driving record.

\*\*Requires correction for depth, groundwater level, and grain size.

**STRENGTH OF COHESIVE SOILS**

Term	Undrained Shear Strength, ksf	Blows Per Foot (SPT) (approximate)
Very Soft	< 0.25	0 to 2
Soft	0.25 to 0.50	2 to 4
Firm	0.50 to 1.00	4 to 8
Stiff	1.00 to 2.00	8 to 16
Very Stiff	2.00 to 4.00	16 to 32
Hard	> 4.00	> 32

**SHEAR STRENGTH TEST METHOD**

U - Unconfined    Q = Unconsolidated - Undrained Triaxial  
 P = Pocket Penetrometer    T = Torvane    V = Miniature Vane    F = Field Vane

**HAND PENETROMETER CORRECTION**

Our experience has shown that the hand penetrometer generally overestimates the in-situ undrained shear strength of over consolidated Pleistocene Gulf Coast clays. These strengths are partially controlled by the presence of macroscopic soil defects such as slickensides, which generally do not influence smaller scale tests like the hand penetrometer. Based on our experience, we have adjusted these field estimates of the undrained shear strength of natural, overconsolidated Pleistocene Gulf Coast soils by multiplying the measured penetrometer reading by a factor of 0.6. These adjusted strength estimates are recorded in the "Shear Strength" column on the boring logs. Except as described in the text, we have not adjusted estimates of the undrained shear strength for projects located outside of the Pleistocene Gulf Coast formations.

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.

**TERMS AND SYMBOLS USED ON BORING LOGS**  
 SOIL CLASSIFICATION (2 of 2)



**APPENDIX A**



6100 HILLCROFT  
PHONE (713) 369-5400

HOUSTON, TEXAS 77081  
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: B-2, S-4 @ 4'

REPORT DATE: 06-02-10

FOR: FUGRO CONSULTANTS, INC.  
HOUSTON, TEXAS

CLIENT NUMBER:

JOB NUMBER: 04.1210-0054

REPORTED TO: SCOTT MARR

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 05-28-10

TIME RECEIVED: 0700

LAB NUMBER: 0528046

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	8.5	SU	ASTM G 51	1400/05-31-10	SD
Sulfate	< 100 *	mg/kg	ASTM D 516	1500/05-31-10	SD
Chloride	< 100 *	mg/kg	ASTM D 512	1430/05-31-10	SD

\* Dry weight basis

SO4 023-10

SCL 013-10

Respectfully submitted,

Steve DeGregorio  
Chemist

SD/mn

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.  
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.



6100 HILLCROFT  
PHONE (713) 369-5400

HOUSTON, TEXAS 77081  
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: B-4, S-3 @ 4'

FOR: FUGRO CONSULTANTS, INC.  
HOUSTON, TEXAS

REPORTED TO: SCOTT MARR

LAB NUMBER: 0528047

REPORT DATE: 06-02-10

CLIENT NUMBER:

JOB NUMBER: 04.1210-0054

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 05-28-10

TIME RECEIVED: 0700

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	8.3	SU	ASTM G 51	1400/05-31-10	SD
Sulfate	144 *	mg/kg	ASTM D 516	1500/05-31-10	SD
Chloride	215 *	mg/kg	ASTM D 512	1430/05-31-10	SD

\* Dry weight basis

SO4 023-10

SCL 013-10

Respectfully submitted,

Steve DeGregorio  
Chemist

SD/mn

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.  
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.



6100 HILLCROFT  
PHONE (713) 369-5400

HOUSTON, TEXAS 77081  
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: B-11, S-3 @ 4'

REPORT DATE: 06-02-10

CLIENT NUMBER:

JOB NUMBER: 04.1210-0054

FOR: FUGRO CONSULTANTS, INC.  
HOUSTON, TEXAS

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

REPORTED TO: SCOTT MARR

SAMPLED BY: CLIENT

DATE RECEIVED: 05-28-10

TIME RECEIVED: 0700

LAB NUMBER: 0528048

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	8.3	SU	ASTM G 51	1400/05-31-10	SD
Sulfate	< 100 *	mg/kg	ASTM D 516	1500/05-31-10	SD
Chloride	< 100 *	mg/kg	ASTM D 512	1430/05-31-10	SD

\* Dry weight basis

SO4 023-10  
SCL 013-10

Respectfully submitted,

Steve DeGregorio  
Chemist

SD/mn