RFP 012115

EWCHEC Monument Sign - Hutto

Addendum #1

Posted Date: 02-5-15

Clarifications

The purpose for this addendum is to provide clarifications and revisions to RFP 012115

- **Attached: Geo-Technical Study by Kleinfelder dated April 16, 2012, for use in design.**

Please sign and date below and attach addendum to the bid package submitted.

I, by signing below acknowledge receipt of the posted addenda, and understand that it becomes part of the bid package for submission.

Signature: ____

Date: ____

KLEINFELDER
Bright People. Right Solutions.

April 16, 2012

Texas State Technical College
3801 Campus Drive
Waco, Texas 76705

Attention: Mr. Henning Hansen
Facilities Manager

Reference: Geotechnical Investigation
TSTC Williamson County Higher Education Center- Phase 1
Hutto, Texas
Kleinfelder Project No. 123016

Dear Mr. Hansen:

Enclosed is an electronic copy of our report on the Geotechnical Investigation for the proposed TSTC Williamson County Higher Education Center- Phase 1 in Hutto, Texas. Our invoice will be submitted under separate cover for your review and payment. We appreciate the opportunity of working for you on this investigation.

As an additional service, we would be pleased to review those portions of the plans and specifications which relied in part on our Geotechnical Investigation report. We can also provide construction phase services such as materials engineering, materials testing, and foundation installation observation.

If you have any questions regarding our report or wish to discuss any additional services, please call me at (254) 754-0369.

Best Regards,
KLEINFELDER CENTRAL, INC.
Texas Registered Engineering Firm F-5592

Appa Rao Hoare

Appa "Ray" Hoare, P.E.
Senior Project Manager

Distribution List:

1. TSTC – Mr. Henning Hansen (1 hard copy and 1 electronic copy via e-mail)

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GEOTECHNICAL INVESTIGATION

TSTC Williamson County Higher Education Center- Phase 1
Hutto, Texas

Kleinfelder Project No. 123016
April 16, 2012

A Report Prepared for:

Texas State Technical College

Waco, Texas

GEOTECHNICAL INVESTIGATION

TSTC Williamson County Higher Education Center- Phase 1
Hutto, Texas

Project No.: 123016
Report No.: WAC12R0226
Date: April 16, 2012

Prepared by:

Appa Rao Hoare

STATE OF TEXAS
APPA RAO HOARE
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LICENSED
PROFESSIONAL ENGINEER
April 16, 2012

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Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from alight industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ-sometimes significantly from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in-this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer For Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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GEOTECHNICAL INVESTIGATION

TSTC WILLIAMSON COUNTY HIGHER EDUCATION CENTER- PHASE 1
HUTTO, TEXAS

1.0 INTRODUCTION

1.1 GENERAL

This investigation of subsurface materials and conditions was performed for the proposed TSTC Williamson County Higher Education Center- Phase 1 in Hutto, Texas (refer to Plates I and II in the Appendix). The project consists of a new building, approximately 120,000 sq. ft, with masonry veneer exterior walls. The north wing of the building will consist of single story high-bay workshops with public spaces, while the south wing will be three stories. The purpose of this investigation has been to:

- Explore the subsurface materials and conditions present at selected, truck accessible site locations by core drilling and sampling;
- Perform laboratory tests to classify the soils and evaluate the strength characteristics of the subsurface materials; and
- Analyze the results of field and laboratory tests to provide limited and specific geotechnical design and construction criteria for the proposed foundations and pavements.

The report is divided into two major sections; i.e., a TEXT section followed by an APPENDIX. The TEXT section contains descriptive information regarding the field operations and laboratory testing as well as results and recommendations based on interpretations of field and laboratory results. The APPENDIX immediately follows the TEXT and contains site and boring location maps, laboratory test results, and the boring logs. Therefore, this report contains both factual data and interpretation of the data, which must not be separated.

1.2 SUBSURFACE EXPLORATION

The drilling operations were conducted on November 2 through 7, 2011 using a CME 55 drill rig. Boring B-3 was re-drilled approximately 5 feet from the original location and has been noted as B-3A. Boring B-3A was drilled on December 12, 2011. The borings were laid out in the field by Kleinfelder personnel based on a site provided by TSTC. GPS coordinates (NAD83) for the boring locations were recorded using a portable handheld GPS receiver, and are listed on the top right corner of the boring logs. The approximate boring locations are also shown on Plate II in the Appendix. Approximate top of boring elevations were estimated based on a site grading plan (Grading Plan, dated February 27, 2012) provided by TSTC. If more precise location and elevation data are desired, then a registered professional land surveyor should be retained to locate the borings and determine the ground surface elevations. The drilling procedures for the core borings are summarized in Table 1.1.

TABLE 1.1: DRILLING PROCEDURES	
Material Type	***Drilling Procedure***
Clay Soils and Clayey Granular Soils	Continuous sampling using hydraulically advanced 3-inch diameter, steel push-tube samplers, or auger drilling in conjunction with standard penetration tests.
Severely Weathered Limestone	Auger drilling in conjunction with standard penetration tests.
Rock Materials	Continuous sampling with an NX-size core barrel equipped with a carbide drill bit or auger drilling in conjunction with standard penetration tests. Core Recovery and Rock Quality Designation (RQD) were recorded during the drilling process.

Samples of the subsurface materials were extruded from the samplers in the field, classified visually, and labeled as to location and depth. Push-tube samples were wrapped in plastic sheeting to minimize moisture changes. Samples were arranged in core boxes and transported to the laboratory for further analysis. During the field operations, the borings were observed for subsurface water. These observations are noted at the bottom of the boring logs and are also discussed in subsequent sections of this report. The core borings were filled and plugged with cuttings after completion.

1.3 LABORATORY TESTS

Samples of subsurface materials from the borings were visually examined and classified in the laboratory. Liquid and plastic limit tests, No. 200-mesh sieve tests, and moisture content tests were performed on selected samples to establish index properties and grain size characteristics, and to properly classify the soils according to the Unified Soil Classification System. The results of these tests expressed as Liquid Limit, Plasticity Index, percent passing the 200-mesh sieve (fines), and moisture content are summarized on Plate III and are also shown on the boring logs.

Strength properties of the soil and rock materials were evaluated through the use of unconfined compression tests on selected push tube and rock core samples. The results of these tests are summarized on Plate III and on the boring logs, which are reported in tons per square feet.

1.4 FIELD TESTS

Standard Penetration Tests (SPT) were performed in the borings to provide in-situ strength estimates and to obtain samples of the clayey granular soils and severely weathered limestone. The SPT tests were conducted in general compliance with applicable ASTM requirements. Results of the SPT tests are shown on the Log of Boring sheet.

The rock materials were qualitatively evaluated using the Rock Quality Designation (RQD) system[1], which is a standard method for rating drill core quality. The RQD values are shown on the boring logs in the column containing the symbol (RQD). RQD is defined as the sum of the lengths of pieces of rock core greater than or equal to four inches in a core run, divided by the total length of that core run. RQD is expressed as a percentage and categorized according to the following Table 1.2.

TABLE 1.2: CLASSIFICATION OF ROCK BY RQD VALUE

RQD	Rock Quality
Less than 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

The percent recovery (REC) is simply the total length of material recovered in a specific core run interval divided by the total length of the core run. The term "fractured" used on the boring logs is a discontinuity in the retrieved core, but does not necessarily represent a continuous failure plane in the rock caused by previous movement or stresses.

2.0 SUBSURFACE MATERIALS AND CONDITIONS

2.1 STRATIGRAPHY AND GEOLOGY

Specific types and depths of subsurface strata observed in the borings drilled for this investigation are shown on the boring log sheets contained in the Appendix. For discussion purposes, the subsurface materials have been divided into major strata types as described below in Table 2.1. The thickness range and general descriptions are based solely on the materials observed in the deeper borings drilled for this investigation.

TABLE 2.1: MAJOR STRATA TYPES IN DEEPER BORINGS

Strata	Depth to Top of Strata (ft)	Depth to Base of Strata (ft)	General Description
I	0	1.5 to 3	FAT CLAY; gray and tan, with calcareous pockets and sand (PLOW ZONE TOP 12 inches)
II	1.5 to 3	4.5 to 10	LEAN CLAY; tan, yellow-tan, gray, and light gray, calcareous, with sand, broken limestone fragments, and mixed with severely weathered limestone
III	4.5 to 10	15 to 40+	SEVERELY WEATHERED LIMESTONE; tan and light gray, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and harder broken harder limestone
IV	5	35.5	MARLY WEATHERED LIMESTONE; tan, fractured, with iron-oxide stains and interbedded softer marl layers (*Present in Boring B-3A only)*
V	15	22.5	WEATHERED LIMESTONE; tan, fractured, with fossils, and interbedded layers of softer marl (*Present in Boring B-9 only)*
VI	18.5 to 35.5	30+ to 55+	MARLY LIMESTONE and LIMESTONE; gray, unweathered, moderately fractured to occasionally fractured, with interbedded layers of softer marl (*Not present in Boring B-3)*

The above descriptions are general and range of depths approximate because boundaries between different strata are seldom clear and abrupt in the field. In addition, the lines separating major strata types on the Log of Boring sheets do not necessarily represent distinct lines of demarcation for the various strata.

Based on the available geologic maps of the area[2], and the contents of the borings, it is our opinion that all of the natural materials are part of the *Austin Chalk Formation*. The Austin Chalk is described as white to grayish-white chalk, limestone, and marl. The term "chalk" is defined as "a very soft, white to light gray, indurated limestone..." while the term "marl" is "a calcareous clay" or "compact impure limestone". At this site, the stratigraphy generally consists of surficial clayey soils overlying tan severely weathered limestone followed by tan weathered limestone and gray limestone with interbedded marly layers. For discussion purposes in this report, weathered limestone and limestone are rock-like while severely weathered limestone is soil-like. Severely weathered limestone encountered in the borings is an intermediate soil-rock product that has weathered in place.

Subsurface conditions encountered in Boring B-3 was different than the remaining borings drilled for this investigation. Therefore, Boring B-3 was re-drilled (Boring B-3A) approximately 5 feet from the original boring location. Subsurface conditions in Boring B-3A consisted of marly weathered limestone below a depth of 5 feet and extended to a depth of 35.5 feet. Gray unweathered limestone was encountered below a depth of 35.5 feet in Boring B-3A.

2.2 SUBSURFACE WATER

The borings were advanced to depths of 10 to 55 feet using dry drilling techniques. Compressed air was used in the rock core drilling process to discharge cuttings. At the time of our field exploration, groundwater was not encountered in the borings.

It is not unusual to encounter shallow groundwater within the Austin Chalk Formation, especially during and after periods of rainfall. The water tends to percolate down through the surficial soils until encountering a relatively impervious layer, and then either flow down gradient or become trapped. Water also tends to fill fractures and joints within the rock mass. The water observations conducted for this investigation are short-term and should not be interpreted as a groundwater study. However, the presence of groundwater may affect construction and long-term performance of the proposed foundations and pavements.

3.0 FOUNDATION DESIGN CRITERIA

3.1 GENERAL

The project consists of a new building, approximately 120,000 sq. ft, with masonry veneer exterior walls. The north wing of the building will consist of single story high-bay workshops with public spaces, while the south wing will be three stories. The elevated floors in the three-story wing will consist of a composite concrete slab supported by composite steel beams and steel columns. The roof over both wings will consist of roof metal deck carried by open web steel joists, wide flange steel beams and steel columns.

We understand that the foundation support for column loads will be 50 to 800 kips. Column loads for the single story wing may range up to 100 kips. The ground-supported floor slab should have a maximum movement potential due to heave or settlement of ± ¾ inch. Additionally, the magnitude of foundation settlement and differential settlement between adjacent foundation elements should be no more than ¾ inch. We also understand that landscaping retaining walls will be constructed. Light parking and entry drives will also be constructed.

Based on the above information, and the results of the borings, specific design and construction recommendations for the foundations are provided in the following sections of this chapter. Pavement thickness design criteria for are summarized in Section 5 of the report.

3.2 EXPANSIVE SOIL CONSIDERATIONS

Clay soils in the Central Texas area are subject to expansive soil movements, which include swelling under moist conditions and shrinking under dry conditions. The moisture fluctuations occur due to seasonal wet and dry cycles, but are also influenced after construction by grading and drainage, landscaping, groundwater conditions, and the presence of paving. Therefore, the soil movement is difficult to determine due to the many unpredictable variables involved.

To estimate the potential expansive soil movement for this site, Texas Department of Transportation (TxDOT's) Potential Vertical Rise (PVR) procedure has been used. The results of the laboratory tests, engineering judgment, and experience have also been considered. Based on TxDOT's method for estimating shrink/swell movements, the calculated potential vertical rise (PVR) for a typical ground supported slab will range from about 2 to 2-½ inches. It must be recognized that these are *not* exact numbers, but only an indication of the approximate range of potential movements. However, this degree of potential movement is considered moderate to high as compared to other sites in the Central Texas area.

Actual soil movements will depend on the subsurface moisture fluctuations over the life of the structure. Soil movements may be less than those calculated if moisture variations are minimized after construction. However, significantly larger soil movements than estimated could occur due to inadequate site grading, poor drainage, ponding of rainfall, and/or leaky water or sprinkler lines.

3.3 STRUCTURAL SUPPORT USING DRILLED PIERS

Based on the size and type of the proposed building, and the subsurface conditions at the site, we recommend that straight-shaft drilled piers be used for structural load support. Gray unweathered limestone should be the bearing stratum. As indicated in the boring logs, gray limestone is present at depths of 18.5 to 25 feet below the existing ground surface. However, gray unweathered limestone was not encountered in Boring B-3 (northwest corner) within the drilled depth.

Drilled piers only in the vicinity of Boring B-3 may be founded in the severely weathered limestone at a depth of at least 20 feet below the existing ground surface or in the limestone with a penetration of at least 3 feet into the bearing stratum (based on Boring B-3A) . Straight-shaft drilled piers founded in the Stratum III tan and light gray SEVERELY WEATHERED LIMESTONE at a depth of at least 20 feet below the existing ground surface may be sized so as not to exceed an allowable end-bearing pressure of <u>15,000 pounds per square foot.</u> An allowable side friction capacity of <u>1,000 pounds per square foot</u> (either tensile or compressive) may be used in the SEVERELY WEATHERED LIMESTONE below a depth of 10 feet.

Straight-shaft drilled piers founded in the Stratum VI gray MARLY LIMESTONE and LIMESTONE may be sized so as not to exceed an allowable end-bearing pressure of <u>40,000 pounds per square foot</u> with a penetration of at least 3 feet into the bearing stratum. An allowable side friction capacity of <u>3,500 pounds per square foot</u> (either tensile or compressive) may be used below the initial 3-ft penetration into the bearing stratum. As mentioned above, an additional allowable side friction capacity of <u>1,000 pounds per square foot</u> (either tensile or compressive) may be used in the SEVERELY WEATHERED LIMESTONE or MARLY WEATHERED LIMESTONE below a depth of 10 feet.

Piers should be specified to terminate atop a hard layer and not within a softer marl layer after the required penetration is achieved. Settlements of properly designed and constructed piers should be less than ¾ inch in severely weathered limestone and ½ inch in the limestone. Terminating the piers within softer marl layers may result in higher settlements.

If the magnitude of the loads or deflection criteria warrants a more in-depth approach, we have the ability to perform a more rigorous analysis using the L-Pile computer program. In order to perform the L-Pile analysis, we will need information from the structural engineer concerning the design shear, moment, and axial loads as well as the drilled shaft geometry. Basic design parameters for the L-Pile 5.0 program are listed in Table 3.1.

TABLE 3.1 L-PILE 5.0 DESIGN PARAMETERS

Boring	Depth (ft)	L/Pile Soil Type	Cohesion (psi)	ϕ (deg)	$\varepsilon 50$ (Soils) or k_rm (Rocks)	Unit Wt (2) (pci)	Modulus, k (pci)	Young's Modulus, E_r (psi)	Uniaxial Comp. Strength (psi)	RQD (%)
B-1, B-2, B-3A, and B-4 thru B-9	0 to 3	Neglect	0 (1)	---	---	---	---	---	---	---
	3 to 10	Stiff Clay w/o Free Water	20	---	0.0055	0.073	800	---	---	---
	10 to 25	Stiff Clay w/o Free Water	35	---	0.0044	0.075	1,600	---	---	---
	25 to 40	Weak Rock	---	---	0.0004	0.078	NA	40,000	700	60
B-3	0 to 3	Neglect	0 (1)	---	---	---	---	---	---	---
	3 to 6.5	Stiff Clay w/o Free Water	20	---	0.0055	0.073	800	---	---	---
	6.5 to 40	Stiff Clay w/o Free Water	35	---	0.0044	0.075	1,600	---	---	---

(1) Minor cohesion, unit weight, and modulus may be used to account for the effect of the overburden soils in the analysis.

(2) Unit weights listed above represent total unit weights. In conditions where soils are below the water table, submerged unit weights should be used. Submerged unit weight is obtained by subtracting the unit weight of water (0.036 pci) from the unit weight listed above.

3.4 INTERIOR FLOOR SLAB

The interior floor slab must be supported on a pad of select fill material achieved by removal of a portion of the expansive clay soils and replacing it with non-expansive imported select fill material. The depth of removal must be at least 4 feet below the final subgrade. The removal should extend a horizontal distance of 2 feet or more beyond the building perimeter. Select fill specifications and compaction requirements are summarized in Section 4.2 of this report. Supporting the floor slab in this manner will result in a PVR value of about ¾ inch or less.

With the removal and replacement method, we recommend that an impervious seal consisting of at least 12 inches of clay soil be constructed on top of the backfill material around the building perimeter. The intent of this impervious seal is to reduce surface runoff water from infiltrating the backfill. The seal must be sloped away from the foundation. In addition, a "plug" of clay soil must be placed at the exit points of the utilities from the foundation to reduce water intrusion into the utility trenches.

The need for vapor barriers, and where to place them, must be determined by the structural engineer based on the proposed floor treatment, building function, concrete properties, placement techniques, and the construction schedule. When moisture barriers are used, precautions should be taken during the initial floor slab concrete curing period to reduce differential curing and possible curling of the slabs.

3.5 STRUCTURAL LOAD SUPPORT FOR LANDSCAPE RETAINING WALLS

The base elevation of the retaining walls will have a major influence on the choice of foundation systems to support the wall. Footings could be used to support the walls provided that enough frictional resistance is available between the base of the footings and the underlying clay soils or severely weathered limestone. Straight-shaft drilled piers extending to a depth of about 10 feet below the existing ground surface into the underlying severely weathered limestone could also be a positive means of structural support. The following paragraphs summarize geotechnical design parameters for both methods.

3.5.1 Footings

Footings founded within the CLAY SOILS or SEVERELY WEATHERED LIMESTONE at a depth of at least 2 feet below the existing ground surface may be sized so as not to exceed an allowable bearing pressure of 2,500 pounds per square foot. Settlements of properly designed and constructed footings should be about 1 inch. An ultimate coefficient of friction of 0.30 may be used at the concrete/soil interface to compute the resistance to base sliding.

3.5.2 Drilled Straight-Shaft Piers

Drilled shafts extending to the severely weathered limestone may be used to resist the shear, overturning, and vertical loads from the retaining walls. Straight-shaft piers extending to a depth of about 10 feet below the existing ground surface and founded in SEVERELY WEATHERED LIMESTONE may be sized for an allowable end-bearing pressure of 6,000 pounds per square foot. An allowable side friction capacity of 500 pounds per square foot (compressive or tensile) may be used below a depth of 5 feet. Settlements of properly designed and constructed piers should be less than 1 inch.

3.6 LATERAL EARTH PRESSURES

The lateral earth pressures on the retaining walls will depend on the restraint conditions of the wall, type of backfill, surcharge pressure, and hydrostatic pressure potential. If the walls are restrained, the at-rest (K_o) earth pressure coefficient will be developed. Active pressures will apply for walls that are allowed to rotate. Table 3.2 includes the earth pressure coefficient and equivalent fluid weights that are recommended for design purposes:

TABLE 3.2: LATERAL EARTH PRESSURE CRITERIA		
Restraint Condition	***Earth Pressure Coefficient***	***Equivalent Fluid Weight (pcf)***
Active (undrained)	K_A= 0.36	83
Active (drained)	K_A= 0.36	43
At-rest (undrained)	K_o = 0.53	93
At-rest (drained)	K_o = 0.53	64

The above values assumes that the retaining wall will be vertical and does not include the effect of hydrostatic pressures or lateral pressures induced by surface loads, which must be taken into account by the structural engineer. These values also assume that the soil behind the walls is excavated at an angle of 1.0 horizontal to 1.0 vertical or flatter, and that the "wedge" of backfill material consists of select fill material. Appropriate factors of safety must be used.

For the drained conditions given above, a subsurface drain system must be included in the design to prevent hydrostatic build-up behind the walls. A granular, free-draining layer adjacent to the back of the walls should be constructed for drainage purposes. In lieu of a conventional drainage system, an approved geo-composite drainage blanket can be placed against the walls and wrapped around a perforated drainage pipe at the base of the foundation.

If drainage material is used behind the retaining walls, it should conform to ASTM C-33, Size 67 Gravel Aggregate. Normal compaction specifications do not apply to clean gravel aggregates; thus, the gravel should simply be compacted in a uniform manner. Over-compaction will result in higher than anticipated pressures on the wall, and should be avoided. Fill material placed within 3 feet of the back face of the wall should be compacted by walk-behind compaction equipment to minimize compaction induced stresses to the wall.

3.7 SEISMIC CONSIDERATIONS

For structural designs based upon the 2009 IBC[(3)], the following Criteria will apply. The Site Class is C. The Mapped Spectral Response Acceleration at short periods (S_S) is about 0.10g, and the Mapped Spectral Response Acceleration at a 1 second period (S_1) is about 0.04g. Site Coefficients F_a and F_V are both 1.2 and 1.7 respectively.

Hazards associated with slope stability, soil liquefaction, surface rupture, and lateral spreading are not considered an issue with this site due to the study area being in a seismically inactive area and the site being underlain at a shallow depth by bedrock.

3.8 UTILITY/SERVICE LINES

Utility and service lines and pipes connected to the structures will move in response to the soil shrink/swell movements. Flexible connections to the structures may be required to accommodate the differential movement. Based on our previous experience, the clay soils are corrosive to buried metals. Corrosion protection should be provided for such metals. If granular backfill materials are used for the utility lines, then a clay plug must be placed at the exterior foundation penetrations to avoid water seeping into the utility trenches.

4.0 FOUNDATION CONSTRUCTION RECOMMENDATIONS

4.1 SITE PREPARATION, GRADING, AND DRAINAGE CONSIDERATIONS

All surficial vegetation, root systems, utilities, and any other underground structures must be removed beneath planned building areas prior to construction. The stripping depth must be based on field observations with particular attention given to old drainage areas, uneven topography, and wet soils. The stripped subgrade must be firm and able to support the construction equipment without displacement. Soft or yielding subgrade must be corrected and made stable before construction proceeds. Proof-rolling should be used to detect soft spots or pumping subgrade areas. Proof-rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or similar piece of equipment weighing at least 25 tons.

Proof-rolling is intended to achieve additional compaction and to locate unstable areas, and must be observed by Kleinfelder. Soft spots or areas of pumping subgrade observed must be undercut and reworked. Where fill placement is planned, the proof-rolling must occur once the existing soils have been excavated and before the fill is placed and compacted. Proof-rolling is intended not only for the foundation area, but also within all areas of pavement, sidewalks, and other locations that will support surface loads. Prior to fill placement, the exposed subgrade must be scarified to a depth of approximately 6 inches; moisture conditioned, and recompacted to the density specified for fill.

Decorative vegetation and irrigation systems must not be located near foundations. It is important to provide proper grading and drainage around the foundation to not only prevent ponding of water but also to quickly remove the water to limit infiltration. As a general guideline, we suggest the following criteria be used for perimeter drainage:

1. The building pad or the finished floor elevation must be elevated from the exterior finished grade to assist in draining the surface water away from the structure.
2. Where possible extend paved surfaces up to the building line to serve as a barrier to soil moisture evaporation and infiltration. These surfaces must slope away from the building.
3. Outlets for gutter systems must discharge water either into storm drains or onto paved surfaces, which quickly remove the water from the area.
4. In those areas where grassed ditches should be used to direct surface water away from the building area, the ditch must be designed hydraulically to accommodate the volume of water. In addition, the ditch centerline should be located well away from the foundation, preferably at least 10 feet, and should be provided with a slope of 3 to 5 percent. The slope from the building to the ditch should be at least 10 percent. The project Civil Engineer should adjust these recommendations as appropriate for the project requirements.
5. Area drains connected to storm drains and/or concrete lined ditches may also be considered to facilitate drainage where other measures are insufficient to handle and quickly remove surface water.

4.2 SELECT FILL MATERIAL

Select fill material must be a "non-expansive", well-graded soil with sufficient binder material for compaction purposes. Select Fill should meet the requirements of 2004 TxDOT Item 247, Type A, Grade 3 or better. If another local source of select fill is desired, the following specification may be used as a guide:

Maximum Aggregate......................................	3 inches
Percent Retained on #4 Sieve	25 - 50
Percent Retained on #40 Sieve	50 - 75
Plasticity Index	5 - 15
Non-Organic	

Please note that locally available "crusher fines" are generally acceptable for use as select fill below the building, provided that these materials are confined by grade beams. However, crusher fines are highly variable and will require evaluation by Kleinfelder on a case-by-case basis. ***However, if heavy floor slab loads are expected, then "crusher fines" must not be used as a select fill below the building.***

The select fill material and near surface onsite soils must be compacted to at least 95% of TEX-113-E (or ASTM D698) maximum dry density near optimum (±3%) moisture content. A maximum compacted lift thickness of six inches must be specified, with each lift tested for compliance prior to the addition of subsequent lifts. The placement and compaction of fill material must be observed, monitored, and tested by Kleinfelder on a full-time basis.

4.3 COMPACTION AND TESTING

Fill must be placed in horizontal lifts. Field density tests must be taken as each lift of fill material is placed. At a minimum, three tests per lift are required. Generally, one field density test per lift for each 5,000 square feet of compacted area is recommended. For small areas or critical areas, the frequency of testing may need to be increased to one test per 2,500 square feet. Each lift must be compacted and tested before another lift is added. The purpose of field density tests is to provide some indication that uniform and adequate compaction is being obtained. The actual quality of the fill, as compacted, must be the responsibility of the contractor and satisfactory results from the tests must not be considered as a guarantee of the quality of the contractor's filling operations.

Backfill placed within utility trenches that cross under pavement or building areas must be properly compacted. Parking, drive, sidewalk, and landscape areas can undergo settlement due to soft backfill within utility trenches. Backfill placed in utility trenches or other excavated areas within the building or paved area must be placed in lifts, compacted, and tested in accordance with these earthwork recommendations. Trenches must be opened a sufficient width to safely allow compaction equipment access to the backfill and to safely allow for confirmation testing to occur. Backfill must be placed in horizontal lifts, and if the trench is over 4 to 5 feet deep, the side slopes must be benched before placing the backfill.

4.4 FOUNDATION CONSTRUCTION CRITERIA

The following construction criteria and general guidance must be observed during foundation construction:

1. A minimum pier shaft diameter of 24 inches is normally specified to allow for cleaning, minimum construction tolerances, and conventional concrete mix designs. Smaller diameters may be used at the discretion of the structural engineer.

2. The foundation construction must be observed by Kleinfelder to determine that the proper bearing material has been reached in accordance with the recommendations given herein.

3. The foundation excavations must be checked for size and cleaned of loose material prior to the placement of concrete. Precautions must be taken during the placement of reinforcement and concrete to prevent the loose excavated material from falling into the excavation.

4. Prior to the placement of concrete, water, if present must be removed from the foundation excavation. Prolonged exposure or inundation of the bearing surface with water may result in changes in bearing strength and compressibility characteristics. If delays occur, the drilled shaft excavation should be deepened and cleaned, in order to provide a fresh bearing surface.

5. Concrete must be placed promptly after the excavations are completed, cleaned, and observed. Under no circumstances must a pier shaft be drilled that cannot be filled with concrete within 4 hours.

6. The reinforcement steel cage placed in the shaft must be designed from the standpoint of meeting two requirements: (1) the structural requirements for the imposed loads; and (2) stability requirements during the placement of concrete.

7. Groundwater was not encountered during our field exploration. Temporary steel casing may be required to seal out groundwater or prevent the pier holes from caving. Special concrete design and construction procedures as described in ACI 336.1 and ACI 336.3R should be specified in order to properly extract the casing during concrete placement. In particular, the pier concrete should be placed at a minimum slump of 6 inches when temporary steel casing is used. Temporary casing may not be required in all the pier holes, so it is advisable that the bid schedule include installation of temporary casing as a separate unit-price bid item.

5.0 PAVEMENT DESIGN AND CONSTRUCTION CRITERIA

5.1 DESIGN CONSIDERATIONS

Pavement thickness designs have been developed for the parking lots and driveway areas. The performance and structural thickness of the pavement depends on several factors including:

- Characteristics of the support soil;
- Magnitude and frequency of wheel load applications;
- Quality of available construction materials;
- Site drainage characteristics; and
- Pavement design life.

Rigid (concrete) pavement is more durable and performs better over a longer period than flexible (asphalt) pavement. However, rigid pavement is usually more costly to construct. If concrete pavement is not used everywhere, such pavement can be used where the benefit of greater durability is especially advantageous. Concrete pavement is especially advised where traffic will stop and go, such as at traffic entrance and exit points, bus loading/unloading areas, and where trash dumpsters will be loaded and unloaded.

Free water in a pavement base and/or subgrade contributes to premature failure of the pavement. Pavement design and construction should ensure that water is never allowed to pond on or near pavements throughout the pavement life, and that surface water is quickly removed from pavement areas. Adequate sloping for quick drainage away from the pavement area should be obvious to the casual observer.

5.2 SUBGRADE SUPPORT CHARACTERISTICS

Based on the subsurface materials observed at the boring locations, the predominant subgrade at this site will be CLAY. The pavement support characteristics of the subgrade materials were estimated from correlations presented in the literature between soil index properties and resilient modulus values. The results are summarized in Table 5.1.

TABLE 5.1: SUBGRADE SUPPORT CHARACTERISTICS

Subgrade	*Resilient Modulus (ksi)*
Clay Soils	4.2

5.3 TRAFFIC ESTIMATES

It is our understanding that the proposed pavements will be primarily subjected to varying traffic ranging from light vehicles in parking areas to occasional truck traffic on the driveways. Because traffic data was not available for this site, we made estimates based on past experience and traffic criteria used for other projects and schools. ***These estimates must be reviewed by the owner because the traffic information has an impact on the pavement thickness and future performance.***

For pavement design purposes, traffic volumes are expressed as the number of Equivalent 18-kip single axle load applications (ESAL) over the theoretical pavement design life, which is assumed to be 20 years. We have summarized values for three primary traffic conditions.

TABLE 5.2: TRAFFIC ESTIMATES

Traffic Area	Typical Traffic	ESAL's	Reference Table
Light Parking	Light cars and pick-up trucks, no heavy vehicles, similar to a low volume residential street	20,000	Table 5.3A
Drive Way Areas	Mainly light cars and pick-up trucks, occasional trucks, similar to a minor residential collector street	100,000	Table 5.3B

With the above in mind, we have computed the approximate types and volumes of different vehicles to aid in the owner's evaluation of the intended uses of the pavements. These estimates should be reviewed if more detailed traffic information becomes available.

TABLE 5.3A: ESTIMATED TRAFFIC CHARACTERISTICS (20,000 ESAL'S – LIGHT VEHICLE PARKING)

Vehicle Type	*Gross Vehicle Weight (kips)*	*Vehicles per Day*
Cars	4	2,000
Pickup Trucks	7	350
Buses or UPS Trucks	46	0
Semi-Trailer Trucks	80	0

TABLE 5.3B: ESTIMATED TRAFFIC CHARACTERISTICS (100,000 ESAL'S – DRIVE WAY AREAS)		
Vehicle Type	***Gross Vehicle Weight (kips)***	***Vehicles per Day (per lane)***
Cars	4	4,000
Pickup Trucks	7	900
Buses or UPS Trucks	46	4
Semi-Trailer Trucks	80	1

5.4 PAVEMENT THICKNESS DESIGNS

The thickness designs included in Tables 5.4A and 5.4B were computed for the pavements utilizing procedures in accordance with 1993 AASHTO[4] and American Concrete Association design guidelines. A reliability value of 85 percent was assigned to the pavement that corresponds to occasional interruption of traffic for pavement repairs. These designs reflect a "Design Life" of 20 years and are subject to the previously described assumptions.

TABLE 5.4A: PAVEMENT THICKNESS RECOMMENDATIONS LIGHT PARKING AREAS- 20,000 ESAL'S			
Traffic Area	**Pavement Type**	**Surface Course**	**Base Course**
Light Parking Areas	Asphalt	2" HMAC	10" CLB or ********************* 7" CLB with GRID or ********************* 7" CLB and 6" LTS
	Reinforced Concrete	5" RCP	6" CLB or 6" LTS
HMAC...Hot-Mix Asphalt Concrete CLB...Crushed Limestone Base GRID...Biaxial Geogrid		RCP... Reinforced Concrete Pavement LTS... Lime Treated Subgrade	

TABLE 5.4B: PAVEMENT THICKNESS RECOMMENDATIONS DRIVE WAY AREAS- 100,000 ESAL'S			
Traffic Area	**Pavement Type**	**Surface Course**	**Base Course**
Drive Way Areas	Asphalt	2.5" HMAC	13" CLB or ********************* 10" CLB with GRID or ********************* 10" CLB and 6" LTS
		3" HMAC	12" CLB or ********************* 9" CLB with GRID or ********************* 9" CLB and 6" LTS
	Reinforced Concrete	6" RCP	6" CLB or 6" LTS
HMAC...Hot-Mix Asphalt Concrete CLB...Crushed Limestone Base GRID...Biaxial Geogrid		RCP... Reinforced Concrete Pavement LTS... Lime Treated Subgrade	

The "design life" of a pavement is defined as the expected life at the end of which reconstruction of the pavement will need to occur. Normal maintenance, including crack sealing, slurry sealing, and/or chip sealing, should be performed during the life of the pavement.

5.4.1 Geogrid

Clay subgrades may be mechanically improved by placing a biaxial geogrid beneath the crushed limestone base (CLB). The primary function of geogrids used in pavements is reinforcement in which the geogrid mechanically improves the engineering properties of the pavement system. Use of a geogrid reduces the structural cross section, extends the projected service life, and serves as a construction aid over soft subgrades. We recommend using TENSAR BX-1100 geogrid.

5.5 PAVEMENTS ON EXPANSIVE SOILS

Pavement design methods are intended to provide an adequate thickness of structural materials over a particular subgrade, such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design does not account for shrink and swell movements of an expansive clay subgrade such as the clay soils on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell movement of the subgrade. It is therefore important to minimize moisture changes in the subgrade to reduce shrink/swell movements.

The pavement and adjacent areas should be well drained. Proper maintenance must be performed on cracks in the pavement surface to prevent water passing through to the base or subbase material. Extending the base material out about 2 feet from the edge of the pavement curb will also aid in reducing edge related cracking. Even with these precautions, some movements and related cracking may still occur, requiring periodic maintenance.

Pavement "islands" often provide a means of water infiltration into the base and subgrade materials below the pavement. If islands are used, then we recommend that a synthetic lining or clay soils be used to limit infiltration of water into the base and subgrade. Water entry into the base and subgrade will cause softening of the materials, and will cause potholes and/or ruts to form.

The presence of trees and vegetation adjacent to paved areas on expansive soils may exacerbate the formation of cracks in these pavements due to moisture loss in the underlying subgrade from transpiration to the root systems of the vegetation. Soil moisture loss from vegetation can extend a distance from the vegetation about equal to its height. The problem is more severe during dry conditions in non-irrigated locations. *In general, concrete pavements perform better than flexible pavements on expansive clay subgrades. In addition, rigid pavements are less susceptible to damage due to turning and wheel movements of large trucks and buses.*

5.6 SPECIFICATIONS

1. Hot-Mix Asphalt Concrete Surface - 2004 TxDOT Item 340, Type C or D.
2. Reinforced Concrete Pavement - RCP should be specified in accordance with TxDOT Item 360, Concrete Pavement. The concrete class should be specified as Class P in accordance with TxDOT Item 421, Portland Cement Concrete.
3. Crushed Limestone Base Material - 2004 TxDOT Item 247, Type A, Grade 2 or better. The material should be compacted in lifts not to exceed 6 inches compacted thickness at a minimum of 100% of TEX-113-E maximum dry density.
4. Natural Subgrade - The natural subgrade that is disturbed should be compacted to at least 95% of TEX-113-E maximum dry density at a moisture content range of -1.0% to +3.0% of optimum moisture content. Fill material should be placed in 6-inch compacted lifts.
5. Lime Treated Subgrade - 2004 TxDOT Item 260, with a lime solids application rate of at least 6 percent by dry soil unit weight. This will result in an application rate of approximately 28 pounds of lime per square yard for a 6 inch lift. The LTS should be compacted in a 6-inch compacted thickness to at least 95% of ASTM D698 (or TEX-113-E) maximum dry density within -1% to +2% of optimum moisture content. Only lime in the aqueous form should be used to avoid harmful dust generation.
6. Geogrid – TENSAR BX1100.

Jointing and reinforcement should conform to the American Concrete Institute *Guide for Design and Construction of Concrete Parking Lots,* ACI Report 330, latest edition. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections.

6.0 DESIGN REVIEW

Kleinfelder was provided with preliminary site plans and design information. The recommendations contained in this report are based on this information. We must be consulted of any changes so that we may re-evaluate our recommendations. We also must be given the opportunity to review construction documents to affirm that our recommendations have been interpreted correctly. We cannot be responsible for misinterpretations if not given the opportunity to review aspects of the project that are based on the contents of this report. Such a review is considered an additional service.

7.0 LIMITATIONS OF THIS INVESTIGATION

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by ***TSTC.*** If ***TSTC*** does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

The scope of services was limited to conducting 9 foundation area borings to depths of 30 to 40 feet and 5 pavement area borings to a depth of 10 feet with associated laboratory testing. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on the information obtained from the borings, the laboratory test results, and the engineering analysis.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil, rock or groundwater conditions could vary between or beyond the points explored. If soil, rock or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated building loads, and the design depths or locations of the foundations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

As the geotechnical engineering firm that performed the geotechnical evaluation for this project, Kleinfelder should be retained to confirm that the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction. This may avoid misinterpretation of the information by other parties and will allow us to review and modify our recommendations if variations in the soil conditions are encountered. As a minimum Kleinfelder should be retained to provide the following continuing services for the project:

- Review the project plans and specifications, including any revisions or modifications;
- Observe and evaluate the site earthwork operations to confirm subgrade soils are suitable for construction of foundations, slabs-on-grade, pavements and placement of engineered fill;
- Confirm engineered fill for the structure and other improvements is placed and compacted per the project specifications;
- Observe foundation bearing soils and rock to confirm conditions are as anticipated; and
- Confirm rock engineering and kinematic conditions are as anticipated in the project design, including as outlined in the plans and specifications.

The scope of this investigation does not include specific activities and investigations designed to reveal whether a solid waste landfill exists upon the subject land tract other than what may be determined through incidental encounter in the soil borings. Such investigations designed for this specific purpose are described and required by TCEQ rules (30 TAC 330.951-330.964) effective March 2006. The scope of this investigation does not include environmental evaluations of surface and subsurface conditions, and the lack of that information in this report does not indicate an absence of potential environmental problems.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction. Furthermore, the contractor should be prepared to handle contamination conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers.

8.0 REFERENCES

(1) Deere, D.U. and D.W. Deere "The Rock Quality Designation (RQD) Index in Practice", In Rock Classification Systems for Engineering Purposes, ASTM STP 984, ASTM, Philadelphia, 1988, pages 91-101.

(2) Geologic Atlas of Texas, Waco Sheet, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, 1972.

(3) International Code Council, International Building Code, Copyright 2009, Publications- 4501 West Flossmoor Road, County Club Hills, Illinois, First printing, February 2009.

(4) AASHTO Guide for Design of Pavement Structures, American Association of State Highway and Transportation Officials, 444 Capitol Street, N.W., Suite 249, Washington, D.C. 1993.

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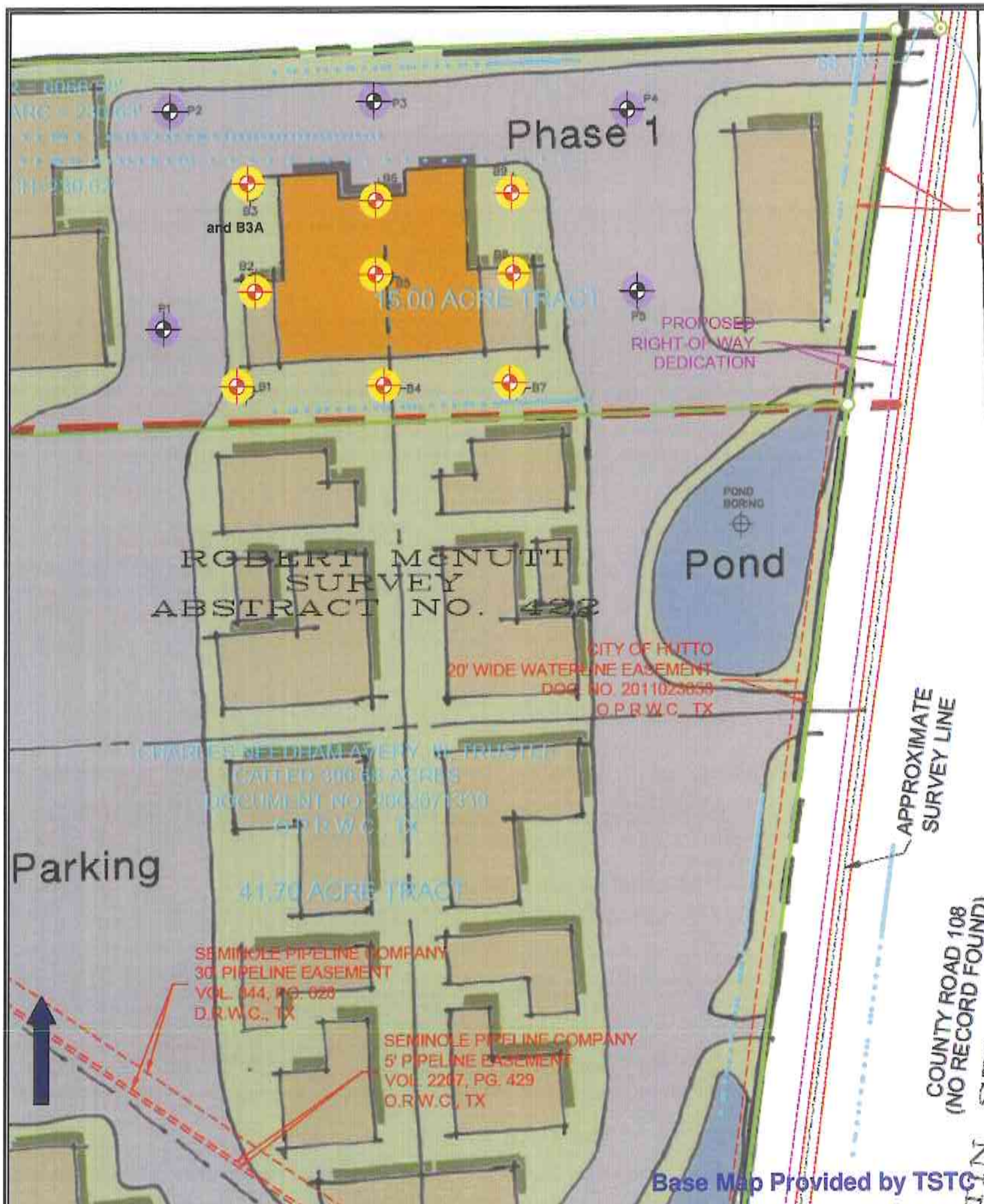
APPENDIX

- *Site Location Map*
- *Boring Location Map*
- *Summary of Laboratory Results*
- *Key to Log of Borings*
- *Log of Borings*
- *Kleinfelder Office Listings*

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 123016	SITE LOCATION MAP	PLATE
	DRAWN : April 16, 2012		
	DRAWN BY : ARH	TSTC WILLIAMSON COUNTY HIGHER EDUCATION CENTER HUTTO, TEXAS	I
	CHECKED BY : SW		
	FILENAME : PLATE I		



KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 123016 DRAWN : April 16, 2012 DRAWN BY : ARH CHECKED BY : SW FILENAME : PLATE II	**BORING LOCATION MAP** TSTC WILLIAMSON COUNTY HIGHER EDUCATION CENTER HUTTO, TEXAS	**PLATE** II

Boring No.	Sample Depth (ft.)	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Moisture Content (%)	Unit Dry Weight (pcf)	Unconfined Compressive Strength (tsf)	Strain at Failure (%)
B-1	0.0 - 2.0	57	22	35	89	12			
B-1	6.5 - 8.0	57	20	37	75	14			
B-1	25.0 - 30.0							62.1	2.2
B-1	25.0 - 25.5							62.1	2.2
B-1	29.4 -							102.4	2.3
B-1	32.0 - 32.5							61.7	2.9
B-1	37.2 - 38.0							101.9	2.4
B-2	2.5 - 4.0	33	18	15	78	14			
B-2	8.5 - 10.0	37	19	18	89	13			
B-2	25.0 - 30.0							39.7	1.7
B-2	25.0 - 25.5							39.7	1.7
B-2	27.8 - 29.0							94.8	2.2
B-3	0.0 - 2.0	67	23	44	89	20			
B-3A	7.5 - 8.2							63.5	1.6
B-3A	16.5 - 18.0							54.1	2.7
B-3A	26.4 - 27.8							62.4	2.4
B-3A	34.5 - 35.0							38.7	2.3
B-3A	41.0 - 41.6							106.9	2.3
B-3A	47.0 - 48.5							124.7	2.6
B-4	2.5 - 4.0	35	18	17	87	12			
B-4	8.5 - 10.0				88	13			
B-4	18.5 - 20.0				93	24			
B-4	25.5 - 26.0							42.4	2.2
B-4	29.2 - 30.0							119.4	2.9
B-5	0.0 - 2.0	75	26	49	90	23			
B-5	4.5 - 6.0				88	15			
B-5	13.5 - 14.5				80	14			
B-5	25.4 - 25.9							53.0	2.0
B-5	31.0 - 32.0							126.5	2.3
B-5	36.7 - 37.2							28.4	2.1
B-6	2.5 - 4.0	73	26	47	94	28			
B-6	6.5 - 8.0	34	18	16	90	15			
B-6	27.8 - 28.4							78.3	1.9
B-7	2.5 - 4.0	44	20	24	89	17			
B-7	8.5 - 9.5	39	18	21	87	14			
B-7	21.5 - 22.0							72.9	2.0
B-7	26.0 - 28.0							82.4	2.2
B-7	33.5 - 34.0							102.4	2.0
B-8	0.0 - 2.0				80	12			
B-8	2.5 - 4.0	40	19	21	73	14			
B-8	13.5 - 15.0				87	14			
B-8	21.8 - 22.5							81.2	2.3

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Summary of Laboratory Results

Project: TSTC Williamson County Higher Education Center-Phase 1

Project Number: 123016

Boring No.	Sample Depth (ft.)	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Moisture Content (%)	Unit Dry Weight (pcf)	Unconfined Compressive Strength (tsf)	Strain at Failure (%)
B-8	28.3 - 29.0							79.6	2.3
B-9	2.0 - 4.0	49	22	27	87	21			
B-9	6.0 - 8.0	32	16	16	73	18			
B-9	16.3 - 17.1							76.3	2.4
B-9	22.2 - 23.1							57.8	2.3
B-9	28.0 - 28.5							37.6	1.7
B-9	33.0 - 35.0							109.7	2.3
P-1	2.0 - 4.0					18	108	14.1	8.8
P-1	6.5 - 8.0				91	17			
P-2	0.0 - 2.0				94	14			
P-2	4.5 - 5.5	38	19	19	85	12			
P-3	2.0 - 4.0					19	106	5.1	5.4
P-3	4.0 - 6.0	46	17	29	83	17			
P-4	0.0 - 2.0	74	26	48	96	17			
P-4	2.0 - 4.0					26	92	5.6	2.3
P-4	6.0 - 8.0				89	17			
P-5	2.0 - 4.0	35	17	18	93	13			

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Summary of Laboratory Results

Project: TSTC Williamson County Higher Education Center-Phase 1

Project Number: 123016

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KEY TO LOGS OF BORINGS

DRILLING AND SAMPLING SYMBOLS AND TERMS:

- Thin-Walled Tube Sample
- Auger Sample/Drilling
- Split Spoon Sample & Standard Penetration Test
- Continuous Core Sample
- TxDOT Cone Penetrometer Test
- Bag Sample
- Water Level Initial Measurement
- Water Level Subsequent Measurement

Hand Penetrometer : An indicator of fine-grained soils consistency. Reported as tons per square foot (tsf).
Core Recovered : Length of rock core recovered as a percent of the total continuous core sample length.
RQD : Rock Quality Designation (RQD) is a measure of the integrity of recovered core samples. Reported in percentage as the sum of core pieces greater than 4 inches in length.
Blow Count : Indicator of soil or rock density/consistency, and correlates to the soil strength. Blow count columns used to report values for both the SPT and the TxDOT Cone Penetrometer. Each column refers to the number of hammer blows required to advance the split spoon sampler or cone 6 inches. Note that the seating blows (first 6 inch drive) are not reported. For the SPT the "N" value is the sum of the values for the second and third drive. In cases where resistance was high during the first, second or third drive, the number of inches of penetration for 50 blows of the hammer is reported.

RELATIVE DENSITY OF COARSE-GRAINED SOILS		CONSISTENCY OF FINE-GRAINED SOILS	
Penetration Resistance Blows/foot	**Relative Density**	**Hand Penetrometer Readings, tsf**	**Consistency (see Note)**
0-4	Very Loose	<0.25	Very Soft
4-10	Loose	0.25-0.5	Soft
10-30	Medium Dense	0.5-1.0	Medium Stiff
30-50	Dense	1.0-2.0	Stiff
over 50	Very Dense	2.0-4.0	Very Stiff
		>4.0	Hard

Note: Some clays may have lower unconfined compressive strengths because of planes of weakness or cracks within the soil. The consistency rating of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE:

Fissured : Containing cracks, usually more or less vertical
Laminated : Composed of thin layers of varying color and texture, typically horizontal
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 intermediate particle sizes
Poorly graded : Predominantly one grain size, or having some intermediate size missing
Slickensided : Having inclined planes of weakness that are slick and glossy in appearance

GENERAL DEGREE OF WEATHERING:

Unweathered : Rock in its natural state before being exposed to weathering agents
Slightly weathered : Noted predominantly by color change with no disintegrated zones
Weathered : Complete color change with zones of slightly decomposed rock
Severely weathered : Complete color change with consistency, texture, and appearance approaching soil

SUBSURFACE CONDITIONS:

Soil and rock descriptions on the boring logs are a compilation from field data as well as from laboratory test results. The stratification lines represent the approximate boundary between materials and the actual transition can be gradual. Water level observations have been made in the borings at the times indicated. Note that fluctuations in groundwater level(s) may occur due to variations in rainfall, hydraulic conductivity of soil strata, construction activity, and other factors.

LOG OF BORING NO. B-1

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55346
Approx. Surface Elevation: 695.0' — Longitude: W 97.57384

Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
4.5				FAT CLAY; gray, with trace sand (PLOW ZONE TOP 12 inches)	57	22	35	89	12			
	24			El. 692.0; 3.0'								
				LEAN CLAY; tan, calcareous, with occasional broken limestone fragments								
				El. 690.5; 4.5'								
	50/ 3½"			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
	67/ 10"				57	20	37	75	14			
	50/ 5"											
	97/ 8.5"											
	58											
				El. 672.0; 23.0'								
	50/ 4"			LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
		100	62								62.1	2.2
											102.4	2.3

Depth: 5, 10, 15, 20, 25, 30

continued on next page

Completion Depth: 40 ft.
Date Boring Started: 11/2/11
Date Boring Completed: 11/2/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

Stratification lines represent approximate strata boundaries, as in-situ the transitions may be gradual. This Log of Boring is not intended for bidding or estimating purposes. Boring log(s) should not be reproduced separately from the engineering report unless said report is specifically included by reference.

LOG OF BORING NO. B-1 (cont'd)

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55346
Approx. Surface Elevation: 695.0' — Longitude: W 97.57384

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
					100	44	LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
														61.7	2.9
35					100	16									
														101.9	2.4
40							El. 655.0; 40.0'								

Completion Depth: 40 ft.
Date Boring Started: 11/2/11
Date Boring Completed: 11/2/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-2

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas Latitude: N 30.55393
Approx. Surface Elevation: 694.0' Longitude: W 97.57377

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray, with sand (PLOW ZONE TOP 12 inches) El. 691.5; 2.5'								
				12			LEAN CLAY; light gray, mixed with sand and severely weathered limestone El. 689.5; 4.5'	33	18	15	78	14			
5				80/ 9.5"			SEVERELY WEATHERED LIMESTONE; tan and light gray, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				50/ 5½"											
				93/ 7"				37	19	18	89	13			
10															
				54			--- tan, with iron-oxide stains below 13.5 feet								
15															
				32											
20															
				50/ 3"			El. 669.0; 25.0'								
25					100	60	MARLY LIMESTONE and LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl							39.7	1.7
														94.8	2.2
30							El. 664.0; 30.0'								

Completion Depth: 30 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 30 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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Stratification lines represent approximate strata boundaries, as in-situ the transitions may be gradual. This Log of Boring is not intended for bidding or estimating purposes. Boring log(s) should not be reproduced separately from the engineering report unless said report is specifically included by reference.

LOG OF BORING NO. B-3

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55437
Approx. Surface Elevation: 693.0' — Longitude: W 97.57376

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0			4.5				FAT CLAY; gray, with sand (PLOW ZONE TOP 12 inches)	67	23	44	89	20			
				12			El. 690.0; 3.0'								
3							LEAN CLAY; tan and yellow-tan, mixed with sand and severely weathered limestone								
5				42											
							El. 686.5; 6.5'								
6.5				50/ 3"			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				50/ 5"											
				50/ 2"											
				48			--- with fossils and iron-oxide stains below 18.5 feet								
				59/ 5½"											
30															

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Completion Depth: 40 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-3 (cont'd)

Project Description:	**TSTC Williamson County Higher Education Center-Phase 1**		
Location:	Hutto, Texas	Latitude:	N 30.55437
Approx. Surface Elevation:	693.0'	Longitude:	W 97.57376

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
							SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				57											
35															
				50/ 11½"											
40							El. 653.0; 40.0'								

Completion Depth: 40 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-3A

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 693.0'
Latitude: N 30.55438
Longitude: W 97.57384

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0			3.5				FAT CLAY; dark gray, very stiff to hard								
			4.5												
4				50/ 5"			El. 689.0; 4.0' SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
5					80	22	El. 688.0; 5.0' MARLY WEATHERED LIMESTONE; tan, fractured, with iron-oxide stains and interbedded softer marl layers								
														63.5	1.6
10					82	14									
15					100	66									
														54.1	2.7
20					44	28									
25					100	94									
														62.4	2.4
30															

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Completion Depth: 55 ft.
Date Boring Started: 12/9/11
Date Boring Completed: 12/9/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 55 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-3A (cont'd)

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 693.0'
Latitude: N 30.55438
Longitude: W 97.57384

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
					100	72	MARLY WEATHERED LIMESTONE; tan, fractured, with iron-oxide stains and interbedded softer marl layers								
35														38.7	2.3
					80	16	El. 657.5; 35.5'								
							LIMESTONE; gray, occasionally fractured, with interbedded layers of softer marl								
40					80	34									
														106.9	2.3
45					60	40									
														124.7	2.6
50					96	96									
55							El. 638.0; 55.0'								

Completion Depth: 55 ft.
Date Boring Started: 12/9/11
Date Boring Completed: 12/9/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 55 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-4

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55348
Approx. Surface Elevation: 691.0' — Longitude: W 97.5735

Depth	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0	4.5				FAT CLAY; gray, with sand (PLOW ZONE TOP 12 inches) El. 689.0; 2.0'								
		55			LEAN CLAY; tan, calcareous, with occasional broken limestone fragments	35	18	17	87	12			
5		78/ 8"			El. 685.5; 5.5'								
		50/ 5½"			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
		99/ 9"							88	13			
10													
		78			--- with fossils below 13.5 feet								
15													
		37			--- with iron-oxide stains below 18.5 feet				93	24			
20					El. 668.5; 22.5'								
		50/ 3"			LIMESTONE and MARLY LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
25			100	90								42.4	2.2
												119.4	2.9
30					El. 661.0; 30.0'								

Completion Depth: 40 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-5

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55403
Approx. Surface Elevation: 692.0' — Longitude: W 97.57349

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0			4.5				FAT CLAY; gray, with trace sand (PLOW ZONE TOP 12 inches)	75	26	49	90	23			
				13											
3.5							El. 688.5; 3.5'								
							LEAN CLAY; tan and light gray, calcareous, with occasional broken limestone fragments								
5				37							88	15			
				40											
8.5							El. 683.5; 8.5'								
				50/ 4"			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
10															
							--- with fossils below 13 feet								
				50/ 5½"							80	14			
15															
				69											
20															
23.0							El. 669.0; 23.0'								
				50/ 4"			LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
25					100	40								53.0	2.0
30															

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Completion Depth: 40 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-5 (cont'd)

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 692.0'
Latitude: N 30.55403
Longitude: W 97.57349

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
					96	62	LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl							126.5	2.3
35					100	82									
														28.4	2.1
40							El. 652.0; 40.0'								

Completion Depth: 40 ft.
Date Boring Started: 11/3/11
Date Boring Completed: 11/3/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-6

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55441
Approx. Surface Elevation: 691.0' — Longitude: W 97.57336

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0			4.5				FAT CLAY; dark gray, (PLOW ZONE TOP 12 inches)								
				6				73	26	47	94	28			
4.0							El. 687.0; 4.0'								
5				14			LEAN CLAY; tan and white, calcareous, with occasional broken limestone fragments								
				29				34	18	16	90	15			
8.5							El. 682.5; 8.5'								
				50/ 5"			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
10															
				50/ 5"											
15															
				50/ 4"											
20															
				50/ 3"											
25							El. 666.0; 25.0'								
					100	52	LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
														78.3	1.9
30							El. 661.0; 30.0'								

Completion Depth: 30 ft.
Date Boring Started: 11/4/11
Date Boring Completed: 11/4/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 30 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-7

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Latitude: N 30.55352
Approx. Surface Elevation: 689.0'
Longitude: W 97.57286

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray, (PLOW ZONE TOP 12 inches)								
							El. 686.5; 2.5'								
				10			LEAN CLAY; gray and tan, calcareous, with occasional broken limestone fragments	44	20	24	89	17			
5				68/ 11¾"											
							El. 683.5; 5.5'								
				50/ 4"			SEVERELY WEATHERED LIMESTONE; tan and light gray, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				50/ 5½"				39	18	21	87	14			
10															
				50/ 5¾"											
15															
							El. 670.5; 18.5'								
				50/ 4"			LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
20					100	60									
														72.9	2.0
25					100	70									
														82.4	2.2
30					100	100									
														102.4	2.0
35							El. 654.0; 35.0'								

Completion Depth: 35 ft.
Date Boring Started: 11/4/11
Date Boring Completed: 11/4/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 35 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-8

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 690.0'
Latitude: N 30.554
Longitude: W 97.5728

Depth	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0	4.5				FAT CLAY; tan and gray, with calcareous pockets and sand				80	12			
					El. 688.0; 2.0'								
		9			LEAN CLAY; tan and gray, calcareous, with sand and broken limestone fragments	40	19	21	73	14			
5		43											
		50/ 1"			El. 683.0; 7.0'								
					SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
		78/ 9"											
10													
		95/ 10"							87	14			
15													
					El. 671.5; 18.5'								
		50/ 3"			LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
20			82	14									
												81.2	2.3
25			90	78									
												79.6	2.3
30					El. 660.0; 30.0'								

Completion Depth: 30 ft.
Date Boring Started: 11/4/11
Date Boring Completed: 11/4/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 30 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. B-9

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Latitude: N 30.55449
Approx. Surface Elevation: 693.0'
Longitude: W 97.57276

Depth	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
	4.5				FAT CLAY; gray (PLOW ZONE TOP 12 inches)								
					El. 691.5; 1.5'								
	4.5				LEAN CLAY; tan and light gray, calcareous, mixed with severely weathered limestone	49	22	27	87	21			
	4.0												
5													
	4.5					32	16	16	73	18			
	4.5												
10					El. 683.0; 10.0'								
					SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
		50/ 5"											
15					El. 678.0; 15.0'								
			84	52	WEATHERED LIMESTONE; tan, fractured, with fossils, and interbedded layers of softer marl								
												76.3	2.4
20			90	72									
					El. 670.5; 22.5'							57.8	2.3
					LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
25			60	50									
												37.6	1.7
30													

continued on next page

Completion Depth: 40 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring above that depth. The boring was backfilled at completion.

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Stratification lines represent approximate strata boundaries, as in-situ the transitions may be gradual. This Log of Boring is not intended for bidding or estimating purposes. Boring log(s) should not be reproduced separately from the engineering report unless said report is specifically included by reference.

LOG OF BORING NO. B-9 (cont'd)

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55449
Approx. Surface Elevation: 693.0' — Longitude: W 97.57276

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
					100	100	LIMESTONE; gray and gray-tan, unweathered, moderately fractured, with fossils and interbedded layers of softer marl								
														109.7	2.3
35					100	84									
40							El. 653.0; 40.0'								

Completion Depth: 40 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 40 feet using dry drilling techniques. Groundwater was not encountered in the boring above that depth. The boring was backfilled at completion.

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LOG OF BORING NO. P-1

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 699.0'
Latitude: N 30.55367
Longitude: W 97.57422

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
0–2.5			4.5				FAT CLAY; gray and gray-tan, with occasional broken limestone fragments (PLOW ZONE TOP 12 inches)								
			4.5				El. 696.5; 2.5'					18	108	14.1	8.8
2.5–5							LEAN CLAY; tan, calcareous, with broken limestone fragments								
5				50/ 4"			El. 694.0; 5.0'								
5–10				55			SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone				91	17			
10				50/ 2"			El. 689.0; 10.0'								

Completion Depth: 10 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 10 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. P-2

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55482
Approx. Surface Elevation: 696.0' — Longitude: W 97.57436

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray, (PLOW ZONE TOP 12 inches)				94	14			
			4.5				El. 693.5; 2.5'								
							LEAN CLAY; tan, calcareous, with broken limestone fragments								
5				50/ 3"			El. 691.0; 5.0'	38	19	19	85	12			
							SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				50/ 4"											
				50/ 5"											
10							El. 686.0; 10.0'								

Completion Depth: 10 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 10 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. P-3

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Latitude: N 30.55482
Approx. Surface Elevation: 690.0'
Longitude: W 97.57338

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray, (PLOW ZONE TOP 12 inches)								
			4.5				El. 687.5; 2.5'					19	106	5.1	5.4
							LEAN CLAY; tan, calcareous, mixed with severely weathered limestone								
			4.0					46	17	29	83	17			
5															
				25											
				49											
10							El. 680.0; 10.0'								

Completion Depth: 10 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 10 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. P-4

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas — Latitude: N 30.55482
Approx. Surface Elevation: 684.0' — Longitude: W 97.57222

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray to dark gray, with occasional calcareous nodules (PLOW ZONE TOP 12 inches)	74	26	48	96	17			
			4.5									26	92	5.6	2.3
			4.5												
5							El. 678.0; 6.0'								
			4.5				LEAN CLAY; tan, calcareous, mixed with severely weathered limestone				89	17			
			4.5												
10							El. 674.0; 10.0'								

Completion Depth: 10 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 10 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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LOG OF BORING NO. P-5

Project Description: **TSTC Williamson County Higher Education Center-Phase 1**
Location: Hutto, Texas
Approx. Surface Elevation: 686.0'
Latitude: N 30.55388
Longitude: W 97.57239

Depth	Symbol/USCS	Samples	Hand Penetrometer, tsf	Penetration, blows/ft	Core Recovered, %	RQD, %	MATERIAL DESCRIPTION	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Moisture Content, %	Unit Dry Weight, pcf	Unc. Compressive Strength, tsf	Strain at Failure, %
			4.5				FAT CLAY; gray and gray-tan, with calcareous deposits and sand (PLOW ZONE TOP 12 inches) El. 684.0; 2.0'								
			3.5				LEAN CLAY; tan, calcareous, with occasional fossils and broken limestone fragments	35	17	18	93	13			
			4.0												
5															
				50/ 3"			El. 679.0; 7.0'								
							SEVERELY WEATHERED LIMESTONE; tan, calcareous, clayey, with sand, broken limestone fragments, and interbedded layers of clay and broken harder limestone								
				50/ 3½"											
10							El. 676.0; 10.0'								

Completion Depth: 10 ft.
Date Boring Started: 11/7/11
Date Boring Completed: 11/7/11
Logged by: M. Radtke
Project No.: 123016

Remarks: Boring was advanced to a depth of 10 feet using dry drilling techniques. Groundwater was not encountered in the boring at the time of drilling. The boring was backfilled at completion.

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