STRATUM
ENGINEERING, LLC
Geotechnical Engineering ♦ Testing and Inspection Services

September 12, 2012

SCNZ Architects
2134 Magazine Street, Suite 200
New Orleans, Louisiana 70130

Attn: Mr. Matt Norton, AIA
Principal

Re: Geotechnical Engineering Report
Proposed HEAT Trainer and
Restroom Building
Camp Villere - Slidell, Louisiana
Project No. G12-042

Dear Mr. Norton:

Stratum Engineering, LLC (SE) is pleased to submit our Geotechnical Engineering Report for the above referenced project. This report includes our field data and laboratory test results, as well as recommendations for foundation design.

We appreciate the opportunity to perform this Geotechnical Study and look forward to working with you during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please do not hesitate to call.

Respectfully submitted,
STRATUM ENGINEERING, LLC

William Dean McInnis, E.I.
Project Manager

Tony Y. Maroun, P.E.
Principal

STATE OF LOUISIANA
TONY Y. MAROUN
License No. 26198
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

WDM/TYM:wdm

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EXECUTIVE SUMMARY

An exploration and evaluation of the subsurface conditions have been completed for the proposed pre-engineered metal HEAT Trainer and Restroom Building to be constructed at Camp Villere in Slidell, Louisiana.

The site of the proposed facility is located on the western side of the Louisiana National Guard Camp Villere Installation. The property is a vacant, relatively flat grassy parcel situated between two existing structures off West Range Road near the St. Tammany Parish Fire Department Training Academy and various law enforcement gun ranges. Although the site is undeveloped, a pump house structure exists on the northeast corner with a water main running along the north perimeter near the existing gun range parking areas.

The project includes the construction of a pre-engineered metal building with a footprint of about 1,800 square feet. Maximum column and wall loads are not known at this time, but are anticipated to be less than 50 kips and 2 kips per foot, respectively. However, the building is being constructed to house a HMMWV Egress Assistance Trainer (HEAT) which has a service load of approximately 6.5 tons and a footprint of about 225 square feet yielding a uniform floor load of about 60 pounds per square foot (psf).

The site was characterized by a total of two (2) borings drilled in the building area to a depth of 20 feet. Based on the borings, the site is generally covered with 8 to 10 inches of silty topsoil with organics. However, thick deposits of silty clay soil, as much as 24 inches, were encountered below the topsoil in both borings. The silty clay was underlain by a layer of firm to stiff orange-tan and gray lean clay with sand to an approximate depth of 6 to 8 feet where firm to stiff tan and gray lean to fat clay were encountered to at least 20 feet, the maximum depth explored. Groundwater was encountered at around 2 feet upon completion of the drilling operations.

Detailed grading information was not available to us at the time this report was prepared. However, based on conversations with Matt Norton of SCNZ Architects, the architects for the project, we understand that the adjacent structures are at or above base flood elevation indicating that the new building will only require minimum cut and fill to reach the necessary design grade.

Based on the field data and laboratory test results, the proposed HEAT Trainer Building may be supported on a shallow foundation system provided the site is prepared as recommended in the report. This will include undercutting the thick deposits of moisture sensitive silty material which could be as thick as 2 feet. Spread footings and continuous wall footings bearing in the naturally occurring stiff clay or compacted structural fill, at least two (2) feet below the finished grades, could be designed for maximum net allowable bearing pressures of 2500 psf and 2000 psf, respectively, based on dead loads and design live loads.

The owner/designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations in preparation of design/construction documents.

PROJECT INFORMATION

Project Authorization

Stratum Engineering, LLC (SE) has completed a geotechnical exploration for the proposed pre-engineered metal HEAT Trainer Building to be constructed at Camp Villere in Slidell, Louisiana. The exploration was accomplished in general accordance with SE Proposal No. G12-087, dated August 16, 2012.

Project Description

The project includes the construction of a pre-engineered metal building with a plan area of approximately 1,800 square feet. We understand the building will be used as a training facility with a small office space and restroom facilities. The training facility will house a HMMWV Egress Assistance Trainer (HEAT) which will be used to train military personnel on rollover and related vehicle emergencies and situations. The HEAT apparatus has a width of 182 inches and a length of 177 inches. The equipment weighs 13,200 pounds (6.5 tons) when fully operational. Assuming the equipment has a uniform weight distribution, the equipment creates a uniform floor load of approximately 60 psf. While the HEAT apparatus is located on the west side of the building, a small office space and multiple restrooms will be provided in the east half of the building. Maximum column and wall loads are not known at this time, but are assumed to be less than 50 kips and 2 kips per foot, respectively.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to enable an evaluation of cost effective foundation systems for the proposed structure. The scope of the study was developed based on our knowledge of the site and our conversations with the project architect regarding its intended use.

The scope of services included drilling a total of two (2) soil borings to a depth of 20 feet below the existing ground surface within the building footprint. In addition to drilling the soil borings, our scope of services included a reconnaissance of the project site, select laboratory testing, and preparation of this geotechnical report. The report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and provides results of analysis and recommendations regarding the following:

- Foundation type, depths, allowable bearing capacities, and estimate of settlements;
- Seismic site classification;
- Site preparation, including subgrade preparation and compaction requirements;
- Factors influencing construction and performance of the proposed development.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The site of the proposed HEAT Trainer Building is located on the southwestern side of the Louisiana National Guard Camp Villere Installation in Slidell, Louisiana. It is situated between two existing structures off West Range Road. The property is relatively flat and covered with grass. Although the site is undeveloped, an existing pump house structure exists on the northeast corner and a water main extends along the north perimeter near the existing gun range parking area.

The site is situated on a military installation and is bordered by a gravel surfaced parking area and multiple gun ranges to the north, St. Tammany Parish Fire Department Training Academy to the south, a small metal building followed by West Range Road to the west and by a small structure followed by other military buildings to the east.

Detailed grading information was not available to us at the time this report was prepared. However, based on conversations with Matt Norton of SCNZ Architects, the architects for the project, we understand that the adjacent structures are at or above base flood elevation indicating that the new building will only require minimum cut and fill to reach the necessary design grade.

Field Exploration

The site was characterized with two (2) borings drilled in the building area to depths of 20 feet. The borings were located in the field by a Stratum Engineering representative using normal taping from existing landmarks as indicated on the boring location plan, which is a reproduction of a drawing provided to us by SCNZ Architects.

Drilling, Sampling, and Laboratory Testing Procedures

The borings were drilled with an ATV mounted drilling rig. Auger drilling techniques were used to advance the borings. Samples were generally obtained continuously from the ground surface to a depth of ten feet and at maximum five foot intervals thereafter. Drilling and sampling techniques were accomplished in general accordance with ASTM Standards.

Undisturbed samples of cohesive soils were generally obtained using thin-wall tube sampling procedures in general accordance with the procedures for "Thin-Walled Tube Geotechnical Sampling of Soils" (ASTM D1587). These samples were extruded in the field with a hydraulic ram and were wrapped in aluminum foil prior to placement in a plastic wrapping to preserve moisture. The samples were transported to the laboratory in containers to prevent disturbance.

The laboratory testing program included supplementary visual classification and water content tests on all of the soil samples. In addition, selected samples were subjected to unconfined compression testing, percent passing the #200 sieve and Atterberg Limits determination. Additional estimates of unconfined compressive strength were made using a hand penetrometer. The laboratory testing was performed in general accordance with ASTM Standard Procedures.

Subsurface Conditions

The site was characterized by a total of two (2) borings drilled in the building area to a depth of 20 feet. Based on the borings, the site is generally covered with 8 to 10 inches of silty topsoil with organics. Below the topsoil, thick deposits of silty clay soil, as much as 24 inches, were encountered in both borings. The silty clay was underlain by a layer of firm to stiff orange-tan and gray lean clay with sand to an approximate depth of 6 to 8 feet where firm to stiff tan and gray lean to fat clay was encountered to at least 20 feet, the maximum depth explored.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at the boring locations. These records include soil descriptions, stratification, penetration resistances, and locations of the samples and laboratory test data. The stratification shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on the boring logs. The samples, which were not altered by laboratory testing, will be retained for 60 days from the date of this report and then will be discarded.

Groundwater Conditions

Groundwater was encountered in the borings at around 2 feet upon completion of drilling operations. The shallow groundwater could be a perched condition which generally occurs at the interface of the surficial granular soils and the underlying low permeability cohesive soils. Although the groundwater levels will fluctuate with seasonal variations in rainfall and extended periods of drought or surface runoff, it is recommended that the actual groundwater level at the site be determined by the contractor at the time of the construction activities.

EVALUATION AND RECOMMENDATIONS

General

The type and depth of foundation suitable for a given structure primarily depends on several factors including the subsurface conditions, the function of the structure, the loads it may carry, the cost of the foundation and the criteria set by the Design Engineer with respect to vertical and differential movement which the structure can withstand without damage.

The results of the exploration indicate that the subsurface soil conditions at the site are generally fair in bearing quality and suitable for support of the proposed structure on a shallow foundation system. However, the results of laboratory tests indicate the near surface soils are extremely moisture sensitive and could loose their support capability if they become saturated. Therefore, depending on the site conditions at the time of construction, about 24 inches of the near surface soils, exclusive of the topsoil, may have to be undercut and replaced with compacted structural fill. Details related to site preparation and foundation recommendations, as well as construction considerations, are presented in subsequent sections of this report.

IBC Site Classification

The International Building Code (IBC), 2003 edition, was reviewed to determine the site classification for seismic design. Based on the shear strength of the soils encountered in the 20 foot deep borings and our experience with the soil condition in the area, the site can be classified as Site Class "D", as outlined in Section 1615.1.1.

Potential Vertical Rise

Field and laboratory test results indicated that the soils encountered within the active zone predominantly consist of silty or lean clays which exhibit low shrink and swell potential. However, some moderately plastic clay was encountered in the borings as they approached a depth of 10 feet below the existing ground surface.

A Potential Vertical Rise (PVR) value of about ½ inch was calculated using the TEX-124E method assuming an active zone of ten (10) feet which is typical for the area. Consequently, the potential for volume change of the soil is expected to be minimal and should not be a factor at this site.

Site Preparation

Site preparation is expected to include, but not be limited to, stripping of the topsoil with organics. Based on the borings, 8 to 10 inches of topsoil with organics was generally encountered at the site. However, the actual stripping depth should be determined by a representative of the Geotechnical Engineer at the time of construction.

In addition to the moisture sensitive silty soil encountered below the topsoil, shallow groundwater was encountered at the site. The perched water condition is expected to keep the near surface soils saturated and could be problematic during earthwork construction. Therefore, depending on the site condition at the time of construction, the near surface silty soil which extends about 24 inches below the surface and potentially some of the underlying wet lean clay will likely have to be undercut to firm clay prior to fill placement.

The subgrade in the building area should be proofrolled with a tandem axle dump truck or a similar heavily loaded rubber tired vehicle weighing 15 to 20 tons. Soils, which are observed to rut or deflect excessively under the moving load, should be undercut and replaced with properly compacted structural fill. The proofrolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

After subgrade preparation and observation have been completed, structural fill placement may begin. The structural fill should consist of sandy clay, silty or clayey sand. The fill should be free of organic or other deleterious materials have a liquid limit less than 40 and a plasticity index between 10 and 18 percent. Structural fill soils with plasticity indices in this range will require close moisture content control to achieve the recommended degree of compaction. The structural fill should be compacted to at least 95 percent of the fill's maximum dry density as determined by ASTM Designation D698.

Should extreme wet conditions be encountered at the subgrade level, it is recommended that an initial 12 to 18 inch lift of sand, with less than 10 percent passing the #200 sieve, be placed on top of the subgrade to bridge over the wet condition. Subsequent lifts of structural fill should be placed in maximum lifts of 8 inches of loose material and should be compacted within 1 percentage point below to 3 percentage points above the optimum moisture content value. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Each lift of compacted fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. The edge of compacted structural fill should extend at least 10 feet beyond the edge of the building.

Crowning the building pads during fill placement, particularly in wet periods, is recommended to minimize ponding of water and allow rapid runoff of surface water. Construction traffic should not be allowed on the building pads during wet weather, where practical.

Shallow Foundation Recommendations

Provided the site is prepared as outlined above, the proposed HEAT Trainer and Restroom Building can be supported on shallow spread footings and continuous wall footings bearing at a depth of at least two (2) feet below the finished grade. Shallow spread and continuous wall footings bearing in the compacted structural fill or in the naturally occurring stiff lean clays can be designed for maximum net allowable bearing pressures of 2,500 and 2,000 pounds per square foot, respectively. Minimum dimensions of 24 inches for spread footings and 18 inches for continuous wall footings should be used in the design, even if the resulting bearing pressure is less than the allowable bearing pressure, to minimize the possibility of a local bearing failure. The recommended bearing capacities include a factor of safety of 3.0.

The uplift resistance of shallow spread footings formed in open excavations should be limited to the weight of the foundation concrete and the soil above it. For preliminary design purposes, the uplift resistance can be computed by using a total unit weight of 115 pcf for the structural fill placed and compacted above the footing and the unit weight of 150 pcf for the concrete. Concrete reinforcing steel should be properly sized to resist uplift forces. We recommend that a factor of safety of at least 1.5 be used when determining the allowable uplift resistance of spread footings.

Soil resistance to horizontal forces is developed by lateral earth pressures acting on the face of the footing and by friction or adhesion on the footing base. We recommend that the allowable passive pressure be computed for spread footing below grade using the following equation:

$$P_p = 1500 + 120H \text{ (Clay)}$$

where P_p is the lateral soil resistance in psf (pounds per square foot) and H is the depth in feet. For exterior footings, H is measured from one (1) foot below adjacent finished grade, provided that the adjacent finished grade extends level and at least beyond a point that makes a 45-degree angle from the bottom of the exterior footing to the finished ground surface.

The top foot of passive resistance at foundations should be neglected unless the ground surface around the footing is covered by concrete or pavement. The resistance to sliding of spread footings bearing in structural fill can be computed by multiplying the footing base contact area by a sliding friction factor of 0.38. Spread footings should also be sized to resist overturning due to moment forces.

The foundation excavations should be observed by a representative of Stratum Engineering prior to steel or concrete placement to assess that the foundation materials are consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of firm, suitable bearing soils or adequately compacted fill as directed by the Geotechnical Engineer.

The footing excavations should be observed and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If it is required that footing excavations be left open for more than one day, they should be protected to reduce changes in moisture content of the bearing soils.

Settlement

Based on results of the field and laboratory tests and the anticipated foundation loads, we estimate that the maximum foundation settlement will be less than 1 inch. Differential settlement between two adjacent columns will be about 50 percent of the total settlement. While settlement of this magnitude is generally considered tolerable for structures of the type proposed, the design of masonry or brick walls should include provisions for liberally spaced, vertical control joints to minimize the affects of cosmetic cracking.

Floor Slab

The floor slab for the proposed building should be supported on a minimum of 24 inches of compacted structural fill. Placement of the new fill and preparation of the subgrade should be performed in accordance with the Site Preparation section of the report. Any soft, unstable soils or unsuitable soils encountered in the building area should be removed prior to additional fill placement and/or floor slab construction. Consideration should be given to placing polyethylene sheeting between the fill and the floor slab to act as a vapor barrier. The floor slab should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

For design purposes, a Modulus of Subgrade Reaction (k) of about 125 pci can be used for the compacted structural fill. The Modulus of Subgrade Reaction can be increased to 200 pci with the use of 6 inches of 610 limstone base which is recommended under the HEAT Trainer slab which is expected to undergo some dynamic loads. The limestone will provide better support and evenly spread the load to the underlying soil as well as provide a working table during construction.

CONSTRUCTION CONSIDERATIONS

Observation and Testing

It is recommended that Stratum Engineering be retained to provide observation and testing of construction activities involved in the foundations and related activities of this project. Stratum Engineering cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the foundations, if not engaged to also provide construction observation and testing for this project.

During site work, inspection of all stripping, proofrolling, and compaction of fill or subgrade soils in the building areas is recommended. Density tests should be performed to verify compaction and moisture content of the fill and base material. Each lift of fill or base material should be tested and approved by the Geotechnical Engineer prior to placement of subsequent lifts.

Inspection should be performed prior to and during concrete placement. Foundation excavations should be observed by the Geotechnical Engineer or his representative to verify that the exposed materials are suitable for support of the structure.

Moisture Sensitive Soils/Weather Related Concerns

The upper silty soils encountered at the site are extremely sensitive to changes in moisture content and may lose significant strength if allowed to become saturated. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. During wet weather periods, increases in the moisture content of the upper soils can cause some reduction in the soil strength and support capabilities. Therefore, it will be advantageous to perform earthwork construction activities during dry weather. The site contractor shall be responsible for maintaining a firm, unyielding and stable subgrade condition. Should the near surface soils become wet, the contractor should be prepared to mitigate these conditions by repeated aeration and exposure to sunlight or by admixture treatment. A representative of the Geotechnical Engineer should be present during site work activities to evaluate the condition of the soil and verify the material is adequate to support the structure.

Drainage and Groundwater Concerns

Water should not be allowed to collect in the foundation excavations, floor slab area, or on the prepared subgrade in the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water around the building.

Groundwater was encountered at a depth of approximately 2 feet. However, it is possible that seasonal variations in precipitation will cause fluctuations of the water table. Additionally, perched water may be encountered in discontinuous zones within the overburden. Any water accumulation should be removed from the excavations by pumping. If excessive and uncontrolled amounts of seepage occur, the Geotechnical Engineer should be consulted.

Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1928, Subpart P". This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavation, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. Stratum Engineering does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

REPORT LIMITATIONS

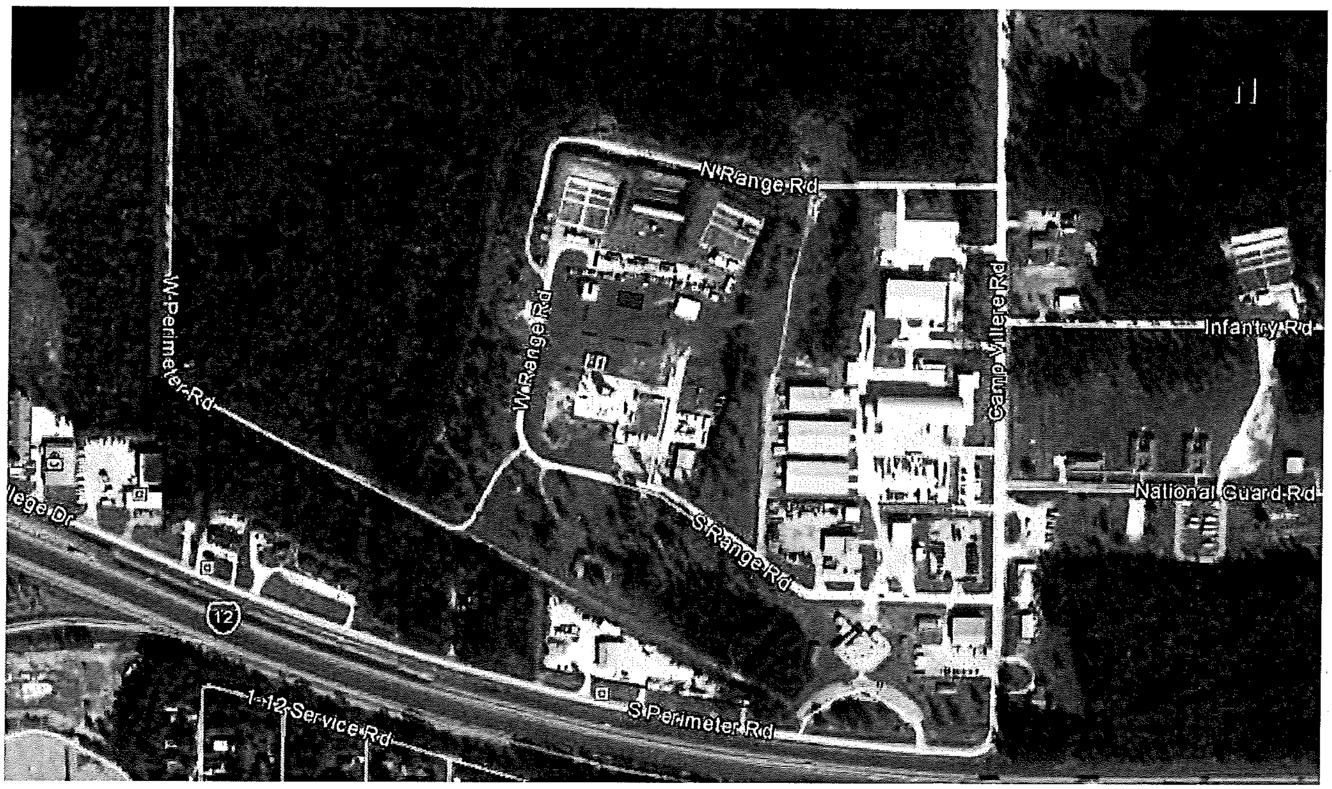
The recommendations submitted in this report are based on the available subsurface information obtained by SE and design details furnished by SCNZ Architects and Heaslip Engineering. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, SE should be notified immediately to determine if changes in the foundation recommendations are required. If SE is not notified of such changes, SE will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated in to the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of SCNZ Architects for the specific application to the proposed pre-engineered metal HEAT Trainer and restroom building to be constructed at Camp Villere in Slidell, Louisiana.

APPENDIX

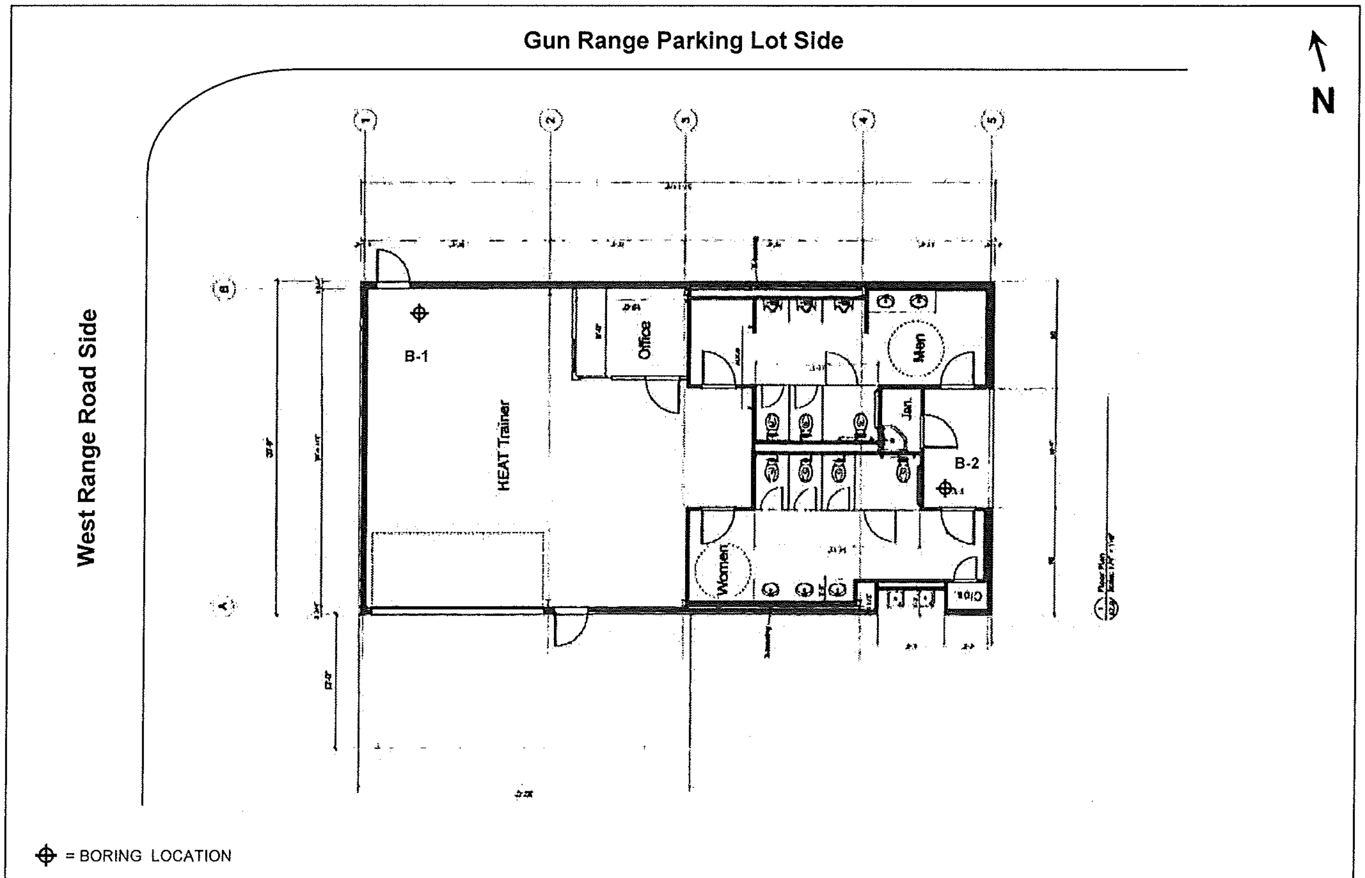
STRATUM
ENGINEERING, LLC



STRATUM ENGINEERING, LLC

SITE VICINITY MAP

GEOTECHNICAL ENGINEERING SERVICES
PROPOSED HEAT TRAINER AND RESTROOM BUILDING
CAMP VILLERE – SLIDELL, LOUISIANA



STRATUM ENGINEERING, LLC

BORING LOCATION PLAN

GEOTECHNICAL ENGINEERING SERVICES
PROPOSED HEAT TRAINER AND RESTROOM BUILDING
CAMP VILLERE – SLIDELL, LOUISIANA

STRATUM ENGINEERING, LLC

LOG OF BORING B-1

PROPOSED HEAT TRAINER AND RESTROOM BUILDING
CAMP VILLERE
SLIDELL, LOUISIANA

TYPE OF BORING: AUGER **LOCATION:** BUILDING AREA **PROJECT NO.:** G12-042

DEPTH, FT.	SOIL TYPE	SAMPLES	DESCRIPTION	N-BLOWS/FT.	UNCONFINED COMPRESSIVE STRENGTH tsf	HAND PENTROMETER tsf	TORVANE tsf	UNIT DRY WEIGHT pcf	MOISTURE CONTENT %	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE
			8" Topsoil with organics Stiff brown and gray Sandy Silty Clay with organics ∇			1.00			20	22	5	69
			Firm orange-tan and gray Lean Clay with sand -with silt seams, 2' to 6'		0.54	1.00		101	22			
5						0.75			20			
			Firm to stiff tan and gray Lean to Fat Clay		0.76	1.25		96	27			
			-becomes light gray at 8'			1.00			28	52	32	
10												
			-becomes very stiff, 13' to 15'			2.50			27			
15												
			-becomes brown and gray at 18'			1.25			30			
20			Boring terminated at 20 feet									
25												
30												
35												
40												
45												
50												

DEPTH OF BORING: 20 feet **GROUNDWATER:** 2' Upon Completion
DATE: 8/22/2012

STRATUM ENGINEERING, LLC

LOG OF BORING B-2

PROPOSED HEAT TRAINER AND RESTROOM BUILDING
CAMP VILLERE
SLIDELL, LOUISIANA

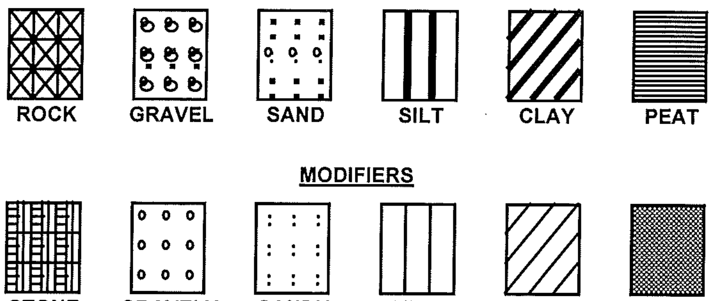
TYPE OF BORING: AUGER **LOCATION:** BUILDING AREA **PROJECT NO.:** G12-042

DEPTH, FT.	SOIL TYPE	SAMPLES	DESCRIPTION	N-BLOWS/FT.	UNCONFINED COMPRESSIVE STRENGTH tsf	HAND PENTROMETER tsf	TORVANE tsf	UNIT DRY WEIGHT pcf	MOISTURE CONTENT %	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE
			10" Topsoil with organics Very stiff dark gray Silty Clay with organics ∇			2.50			22			
			Firm to stiff orange-tan and gray Lean Clay with sand -with silt seams, 2' to 5'		0.39	0.75		100	22	42	24	81
5			-becomes light gray at 4'			1.50			20			
					0.89	1.75		106	23	47	30	
10			Stiff tan and gray Lean to Fat Clay			1.50			29			
15						1.50			27			
20			-becomes very stiff, brown and gray at 18'			2.25			31			
			Boring terminated at 20 feet									
25												
30												
35												
40												
45												
50												

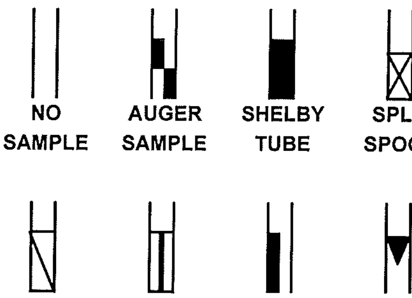
DEPTH OF BORING: 20 feet **GROUNDWATER:** 2' Upon Completion
DATE: 8/22/2012

KEY TO TERMS AND SYMBOLS USED ON LOGS

SOIL TYPE



SAMPLER TYPE



UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487 (1980)

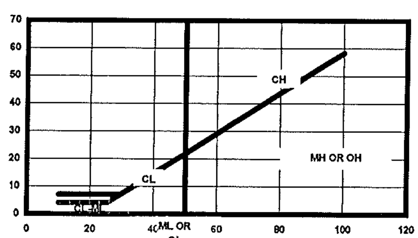
MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE	GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING NO. 4 SIEVE	CLEAN GRAVEL (LITTLE OR NO FINES	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		W/ APPRECIA BLE FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% PASSING NO. 4 SIEVE	CLEAN SANDS LITTLE FINES	SW	WELL GRADED SAND, GRAVELY SAND (LITTLE FINES)
			SP	POORLY GRADED SANDS, GRAVELY SAND (L.FINES)
		SANDS WITH APPREA. FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS,SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/ LOW PI
			CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
HIGHLY ORGANIC SOIL			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNCLASSIFIED FILL MATERIALS			ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS AND MAN-MADE SOIL MIXTURES	

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	SHEAR STRENGTH IN TONS/FT^2
VERY SOFT	0. TO 0.125
SOFT	0.125 TO 0.25
FIRM	0.25 TO 0.5
STIFF	0.5 TO 1.0
VERY STIFF	1.0 TO 2.0
HARD	> 2.0 OR 2.0+

RELATIVE DENSITY - GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS/FOOT)
VERY LOOSE	0-4
LOOSE	4-9
MEDIUM DENSE	10-29
DENSE	30-49
VERY DENSE	> 50 OR 50+



ABBREVIATIONS

HP - HAND PENETROMETER
TV - TORVANE
MV - MINIATURE VANE
UC - UNCONFINED COMPRESSION TEST
UU - UNCONSOLIDATED UNDRAINED TRAIXIAL
CU - CONSOLIDATED UNDRAINED

NOTE: PLOT INDICATES SHEAR STRENGTH AS OBTAINED BY ABOVE TESTS

▼ DELAYED GROUNDWATER LVL

▽ LEVEL GROUNDWATER ENCOUNTERED

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6" 3" 3/4" 4 10 40 200

BOUL--DERS	COBBLES	GRAVEL		SAND			SILT OR CLAY	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

152 76.2 19.1 4.76 2.0 0.42 0.074 0.002

GRAIN SIZE IN MM