

March 16, 2015

SPUR Design  
7700 North Hudson Avenue, Suite 9  
Oklahoma City, OK 73116

Attn: Mr. David Kim

Re: Geotechnical Engineering Services Report  
Cancer Treatment Center  
Overton Brooks VA Medical Center  
Shreveport, Louisiana  
PSI Project Number 02751054

Dear Mr. Kim:

Thank you for choosing Professional Service Industries, Inc. (PSI) as your consultant for the referenced project. Per your authorization, PSI has completed a geotechnical engineering study for the site. The results of the study are discussed in the accompanying report.

If you have any questions pertaining to this report, please contact our office at (318) 631-5547. PSI would be pleased to continue providing services throughout the construction of the project, and we look forward to working with you and your organization on this and future projects.

Respectfully submitted,  
**PROFESSIONAL SERVICE INDUSTRIES, INC.**

Matthew D. Redmon, P.E.  
Project Engineer  
Geotechnical Engineering Services

Sheng-Zong John Ho, Ph.D.  
Principal Consultant



**GEOTECHNICAL ENGINEERING SERVICES REPORT**

**CANCER TREATMENT CENTER  
OVERTON BROOKS VA MEDICAL CENTER  
SHREVEPORT, LOUISIANA  
PSI PROJECT NUMBER: 02751054**

**PREPARED FOR**

**SPUR DESIGN  
7700 NORTH HUDSON AVENUE, SUITE 9  
OKLAHOMA CITY, OK 73116**

**BY**

**PROFESSIONAL SERVICE INDUSTRIES, INC.  
4123 CURTIS LANE  
SHREVEPORT, LOUISIANA 71109**

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## PROJECT INFORMATION

### Project Authorization

Professional Service Industries, Inc. (PSI) has completed a geotechnical exploration for the proposed Cancer Treatment Center at Overton Brooks VA Medical Center in Shreveport, LA. Our services were authorized by Mr. Seth Cavin of SPUR Design on February 16, 2015 by signing our proposal. This exploration was accomplished in general accordance with PSI Proposal No. 0275-143642 dated January 29, 2015.

### Project Description

Project information was provided by Mr. David Kim of SPUR DESIGN on January 27, 2015. We were also provided with a furnished site layout plan, Sheet C1.0, prepared by H2B, Inc.

We understand the proposed project will involve the construction of a cancer treatment center located in the southeast corner of the Overton Brooks VA Medical Center complex in Shreveport, LA. The building will be a two-story structure. The majority of the structure will be steel-framed construction, but the south end of the building will be a concrete construction housing two linear accelerators. Structural loads were not provided; however, based upon PSI's experience with similar projects, we anticipate individual column and bearing wall loads of up to approximately 250 kips and 5 kips per linear foot, respectively.

It is understood that a retaining structure with a maximum height of approximately 15 feet is proposed around the structure on the east, south and west sides. PSI understands that choice of retaining wall type has not been decided at this time. For the purposes of this report, it is assumed that the wall will be a conventional cantilever wall consisting of cast-in-place concrete.

The geotechnical recommendations presented in this report are based on the available project information and the subsurface materials described in this report. If any of the information noted is incorrect, please inform PSI in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

### Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to prepare recommendations for foundation systems for the proposed construction. PSI's contracted scope of services included drilling four soil test borings at the site, to depths of approximately 25 feet to 50 feet below the ground surface, select laboratory testing, and preparation of this geotechnical report. The boring locations and depths were recommended by PSI. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:

- Site Preparation.
- Foundation types, depths, allowable bearing capacities, and an estimate of potential settlement.

- Comments regarding factors which could impact construction and performance of the proposed construction.

The scope of geotechnical services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on, below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

PSI's scope also did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service designed or intended to prevent or lower the risk of the occurrence or amplification of the same. Client should be aware mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Client should be aware the site conditions are outside of PSI's control, and mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or reoccurrence of mold amplification.

## **SITE AND SUBSURFACE CONDITIONS**

### Site Location and Description

The site for the proposed Cancer Treatment Center is located at the Overton Brooks VA Medical Center in Shreveport, Louisiana. More specifically, the site is located east of the Dental Clinic. The site latitude and longitude are approximately N 32.500820° and W -93.720483°, respectively.

The medical complex consists of medical buildings, parking lots and areas of lightly-wooded land. The project area is situated at the top of a hill. An existing asphalt parking lot is located northwest of the project area. The top of the hill was relatively level and covered with grass and small to large trees. The elevation decreases approximately 35 to 40 feet on the east, south and west sides of the project area. Ground surface elevations ranged from a maximum of approximately EL220 feet MSL at the top of the hill to a minimum of approximately EL180 feet MSL at the bottom of the hill on the east side of the project area. The ground surface elevations were secured by interpolation from the site layout plan prepared by H2B, Inc.

Due to recent wet weather, the surficial soils were soft to firm at the time of the field exploration. Our track-mounted drill rig experienced little difficulty in moving about the site.

### Site Geology

Based on the Geologic Map of Louisiana (1984) provided by the Louisiana Geological Society, the proposed site is located on Natural Levees generally consisting of gray and brown silt, silty clay and some very fine sand, reddish brown along the Red River.

### Subsurface Conditions

The site subsurface conditions were explored with four soil test borings. Two borings were drilled to depths of approximately 25 feet and two borings were drilled to a depths of approximately 40 to 44 feet. Auger refusal was encountered in Borings B-3 and B-4 at depths of approximately 44 feet and 40 feet, respectively.

The boring locations and depths were suggested by PSI and reviewed with the client prior to drilling. PSI personnel staked the borings in the field by measuring distances from available site reference points and using a handheld GPS. Please see the attached Boring Location Plan in the Appendix for the locations of the borings.

The borings were advanced with a Geoprobe 7822DT track-mounted drilling rig utilizing hollow stem auger drilling methods. Soil samples were routinely obtained during the drilling process. The soils were generally sampled using the Standard Penetration Test (ASTM D 1586) and Shelby Tube samplers (ASTM 1587). The samples were identified according to boring number and depth, placed in polyethylene plastic wrapping to protect against moisture loss, and transported to the laboratory in protective containers to prevent damage. Select soil samples were later tested in the laboratory to obtain soil material properties for the foundation recommendations. Drilling, sampling, and laboratory testing was accomplished in general accordance with ASTM procedures.

Borings encountered 3 to 4 inches of topsoil. The soils encountered at the site generally consist of very soft to stiff lean and fat clay to a depth of approximately 6 feet underlain by very stiff to hard lean and fat clay with silt lenses to the boring termination depths of approximately 25 feet at borings B-1 and B-2 and approximately 40 to 44 feet in borings B-3 and B-4. Very loose clayey sand and very soft sandy lean clay were encountered at a depth of approximately 6 feet in borings B-1 and B-2. Lignite was observed in the soil samples of borings B-3 and B-4 at depths ranging from 28 to 40 feet. The clays soils sampled had plasticity index (PI) values in a range associated with a low to moderate potential for volume changes with variations in soil moisture contents.

Split-spoon sampling refusal was encountered in two of the borings where blow counts were greater than 50 blows per 6 inches. These materials were encountered in Borings B-3 and B-4 at depths ranging from approximately 28 to 40 feet below the existing ground surface.

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

### Groundwater

Groundwater was not encountered upon completion of drilling, indicating that the stabilized groundwater level at the site at the time of the exploration was either below the terminated depths of the borings or that the soils encountered were relatively impermeable. Although groundwater was not encountered at this time, it is possible for groundwater to exist within the depths explored during other times of the year depending upon climatic and rainfall conditions. The groundwater information presented in this report is the information that was collected at the time of our field activities. We recommend that the contractor determine the actual groundwater level at the site at the time of the construction activities.

### Seismic Design Considerations

The project site is located within a municipality that employs the 2012 International Building Code (IBC). As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site. As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Site Class for this project, we have interpreted the results of soil test borings drilled within the project site and have estimated appropriate soil properties below the base of the borings to a depth of 100 feet as permitted by the code. The estimated soil properties were based upon our experience with subsurface conditions and published geological information in the general site area. Based upon our evaluation, it is our opinion the subsurface conditions within the site are consistent with the characteristics of a Site Class "D" as defined in Section 1613.5.2 of the IBC. Based on the USGS website and Site Class "D", the ground motion values near Latitude N 32.500820° and Longitude W -93.720483°, are presented in Table 1.

**Table 1: Seismic Ground Motion Values**

<b>Period (seconds)</b>	<b>Mapped Spectral Response Acceleration</b>	<b>Site Coefficients</b>	<b>Max. Spectral Acceleration Parameters</b>	<b>Design Spectral Acceleration Parameters</b>
0.2 (S <sub>s</sub> )	0.126 g	F <sub>a</sub> = 1.6	S <sub>MS</sub> = 0.201 g	S <sub>DS</sub> = 0.134 g
1.0 (S <sub>1</sub> )	0.071 g	F <sub>v</sub> = 2.4	S <sub>M1</sub> = 0.170 g	S <sub>D1</sub> = 0.113 g

The Site Coefficients, F<sub>a</sub> and F<sub>v</sub> were interpolated from IBC 2012 Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classifications and the mapped spectral response acceleration at the short (S<sub>s</sub>) and 1 second (S<sub>1</sub>) periods.

## GEOTECHNICAL RECOMMENDATIONS

### Geotechnical Discussion

Due to the very loose clayey sands and the very soft to firm clay soils generally encountered in the upper six to eight feet during the field exploration, a deep foundation system consisting of drilled shafts is recommended to support the anticipated moderate to heavy structural loads. The site offers good end-bearing capacities for drilled shafts to be founded with sufficient embedment in the very stiff and hard clay layers; shaft size will likely control the design.

The following geotechnical related recommendations have been developed on the basis of the subsurface conditions encountered and PSI's understanding of the proposed development. Should changes in the project criteria occur, a review must be made by PSI to determine if modifications to our recommendations will be required.

### Site Preparation

We recommend that topsoil, vegetation, trees, roots, old pavements, any soft/loose soils or other deleterious material in the construction areas be stripped from the site and either wasted or stockpiled for later use in landscaping (subject to the approval of the landscape architect. Voids resulting from the removal of organic material or unsuitable soils should be backfilled in accordance with the following recommendations for fill placement as soon as practical.

After stripping and excavating to the proposed subgrade level, as required, the exposed soils in the structure areas should be proof-rolled with a loaded tandem axle dump truck or similar pneumatic tired vehicle having a minimum gross weight of 20 tons. Soils observed to rut or deflect excessively (typically greater than one inch) under the moving load should be undercut to either a level of competent soil or a maximum depth of three feet and either recompacted or replaced with properly compacted select fill material. The proof-rolling and undercutting activities should be witnessed by a representative of the geotechnical engineer. In order to avoid the possible remedial costs and delays associated with proof-rolling wet and weakened soils, this activity should be performed during a period of dry weather. After proof-rolling and repairs, the subgrade soils should be scarified to a depth of at least 6 inches below the surface and compacted to at least 95% of the Standard Proctor (ASTM D-698) maximum dry density.

After subgrade preparation and observation have been completed any necessary fill placement to attain finished grade may begin. The first layer of fill should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils. Fill materials should be select soil free of organic or other deleterious materials and have a maximum particle size of less than 3 inches. Select fill should have a liquid limit of 40 or less with plasticity index (PI) values between 8 and 20. Excavated in-situ soils meeting select fill criteria are suitable for reuse as fill. If engineered fill placement must proceed during a wet time of the year, it will likely be infeasible to re-use the on-site soils as engineered fill, and imported fill materials will be required.



Fill should be placed in maximum loose lift heights of 8 inches and compacted to at least 95% of the Standard Proctor (ASTM D-698) maximum dry density. The required density will be more readily attained if compaction is done within a range of -1 to +2 percent of the optimum moisture content. If the fill is too dry, water should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Compacted fill should extend a minimum of four feet beyond the foundation perimeter prior to sloping in fill areas.

Each lift of compacted fill should be tested and documented by a representative of the geotechnical engineer prior to placement of subsequent lifts. Tests should be performed at a frequency not less than one test per lift for every 2,500 square feet of fill placed in the building pad areas. There should be a minimum of two tests per lift.

Tested fill materials not meeting either the required dry density or moisture content range shall be recorded, the location noted, and reported to the Contractor and Owner. A re-test of that area should be performed after the Contractor performs remedial measures.

#### Drilled Shaft Recommendations

Due to the unsuitable soils encountered in the upper six to eight feet during the field exploration, a deep foundation system using drilled and cast-in-place shafts can be used to support the proposed structure. The drilled shafts should extend through the soft and loose soils. At a minimum, the drilled shafts should be embedded at least 15 feet below the existing grade. The drilled shafts should have a minimum diameter of at least 24 inches. Provided in the following table on are allowable loads for various diameter shafts and various elevations.

**Table 2: Drilled Shaft Design Parameters**

<b>Diameter (inches)</b>	<b>Depth Below Existing Grade (feet)</b>	<b>Allowable Loads (tons)</b>
24	15	16
24	20	28
24	25	35
30	15	20
30	20	39
30	25	48

The bearing values provided were adjusted by a factor of safety of three.

A minimum shaft spacing of three diameters on centers, based on the larger diameter, should be observed between shafts. Once structural loads are finalized, PSI should be given the opportunity to check the final length, embedment depth and bearing elevation.

The ability of the drilled shaft foundations to resist lateral loading and overturning moment is based on mobilization of the full in-situ soil strength from the ground surface to depths below the base of the drilled shaft. Loosening and sloughing of the soils within the sides and/or base of the drilled shaft excavations or failure to remove accumulated loose soils at the base of the drilled shaft excavations will degrade the soil strength and may lead to excessive foundation deflections and unsatisfactory foundation performance.

Concrete placed in the drilled shaft excavations should have a high slump (about 6 inches) to minimize the potential for the formation of voids. The concrete mix should be designed to attain the required strength when placed at such a slump. Concrete should be placed using a tremie pipe or other means and be pumped to the bottom of the drilled shaft without striking the side walls of the excavation.

The above recommendations assume that the drilled shafts have adequate structural capacity. The structural components (reinforcing steel and concrete) of the drilled shaft foundations should be designed by the project structural engineer.

Cave-ins and sloughing should be expected during drilled shaft excavations in loose sandy soils and soft clays. Casing should be made available on-site prior to construction to prevent cave-ins or sloughing. The drilled shaft contractor chosen for this project should be experienced drilling in the local soil types.

#### Slab-on-Grade Recommendations

Non-structural floor slabs can bear directly on the prepared select fill. For a slab bearing on select (engineered) fill installed as recommended, a modulus of subgrade reaction,  $k$  value, of 130 pounds per cubic inch (pci) may be used in the slab design based on correlation to values typically resulting from a 1 foot by 1 foot plate load test. The designer should consider the use of a vapor barrier under the slab where the floor will be in contact with moisture sensitive equipment or products such as tile, wood, carpet, etc., as directed by the design engineer.

#### Retaining Wall Recommendations

We understand retaining walls approximately 15 feet in height are planned along the eastern, southern and western edges of the project area. Retaining walls should be designed to resist lateral earth pressures. Lateral earth pressure is developed from the soils present within a wedge formed by the vertical below-grade retaining wall and an imaginary line extending up and away from the bottom of the wall at an approximate 45° angle. The lateral earth pressures are determined by multiplying the vertical applied pressure by the appropriate lateral earth pressure coefficient  $K$ . If the walls are not free to rotate or deflect at the top, PSI recommends designing the walls for the “at-rest” lateral earth pressure condition using  $K_0$ . Walls permitted to rotate and deflect at the top can be designed for the active lateral earth pressure condition using  $K_a$ . Passive pressure can be determined using  $K_p$ , with a factor of safety of 2.0. Recommended parameters for use in retaining walls are as follows:

Recommended Parameters for use in Retaining Wall Design	
Material Type	Drained Friction Angle ( $\phi'$ )
In-Situ Clay	Not recommended for wall backfill
Sand (compacted with < 10 % fines)	30°
Clean Crushed Limestone	35°
Total Soil Density (pcf)	125
Approximate Groundwater Elevation	Not Encountered in upper 40 feet

Parameters specific to soil type	Sand*	Limestone*
Friction Factor for Base	0.42	0.47
Coefficient of Active Pressure ( $K_a$ ) **	0.33	0.27
Coefficient of Passive Pressure ( $K_p$ ) **	3.00	3.69
Coefficient of At-Rest Pressure ( $K_o$ ) **	0.50	0.43

\* These values may be used for design only if the sand and crushed limestone backfill extends back from the wall certain distances. These are a horizontal distance approximately equal to or greater than the total height of the wall at the surface.

\*\* Earth pressure coefficients valid for level backfill conditions with no surcharge

The values presented above were calculated based on positive foundation drainage being provided to prevent the buildup of hydrostatic pressure. If surface loads are placed near the walls, they should be designed to resist an additional uniform lateral load of one-half of the vertical surface loads. An “equivalent fluid” pressure can be obtained from the above chart by multiplying the appropriate K-factor times the total unit weight of the soil. This applies to unsaturated conditions only. If a saturated “equivalent fluid” pressure is needed, the effective unit weight (total unit weight minus unit weight of water) should be multiplied times the appropriate K-factor and the unit weight of water added to that resultant. However, PSI does not recommend that earth retaining walls be designed with a hydrostatic load and that drainage should be provided to relieve the pressure.

Backfill of the proposed retaining walls may consist of sand or granular material. PSI suggests using sand or granular material to provide improved drainage and to reduce lateral pressures on the walls resulting from water pressure. Granular material behind the wall should extend no deeper than the top of the wall footing and should be separated from backfill soil by a geotextile fabric. Backfill behind the wall should have a maximum slope of one to one in order to prevent the development of a failure plane in the backfill.

The backfill materials should be placed in 8-inch thick loose layers and compacted to at least 95% of the Standard Proctor (ASTM D-698) maximum dry density. We recommend that backfill directly behind the walls be compacted with hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 5 to 10 feet of the wall during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

The footing for the proposed retaining wall can be supported using continuous footings bearing at least 24 inches below final grade in very stiff in-situ clays. The outer edges of the retaining wall footings should be kept at least five feet away from the descending slope face. Continuous footings for walls can be designed for an allowable soil bearing pressure of 2,500 psf. A minimum dimension of 18 inches for continuous footings should be used in foundation design to minimize the possibility of a local bearing capacity failure.

The foundation excavations should be observed and documented by a representative of PSI prior to steel or concrete placement to assess the foundation materials are consistent with the materials discussed in this report, and therefore are capable of supporting the design loads. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of suitable natural soils and replaced with select fill. Fill placed below the foundations where unsuitable materials are removed should extend one foot outside the foundation limits for every one foot in thickness between the intended bearing surface and the underlying, suitable natural soils.

After opening, foundation 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 possible, the foundation concrete should be placed during the same day the excavation is made. Foundation excavations left open for more than one day they should be protected to reduce evaporation or moisture entry. We recommend that a representative of the geotechnical engineer be present to observe foundation excavations and fill placement.

## **CONSTRUCTION CONSIDERATIONS**

PSI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. PSI cannot accept responsibility for conditions that deviate from those described in this report, nor for the performance of the foundation system if not engaged to also provide construction observation and testing for this project.

### Moisture-Sensitive Soils/Weather Related Concerns

The upper fine-grained soils encountered at this site are expected to be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

### Drainage and Groundwater Considerations

PSI recommends that the contractor determine the actual groundwater levels at the site at the time of the construction activities to assess the impact groundwater may have on construction. While groundwater was not encountered in the borings at the time of our field exploration, it is possible that seasonal variations will cause fluctuations or a water table to be present in the upper soils at a later time.

Water should not be allowed to collect in the foundation excavations, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Water should be removed from excavations by pumping. Should excessive and uncontrolled amounts of seepage occur, the geotechnical engineer should be consulted.

Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slabs. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.

## Excavations

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. PSI understands 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.

PSI is providing this information solely as a service to our client. PSI 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 are based on the available subsurface information obtained by PSI and preliminary design details furnished by the client. If there are revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions 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 into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of SPUR Design for the specific application to the proposed Cancer Treatment Center at Overton Brooks VA Medical Center in Shreveport, Louisiana.

## Appendix





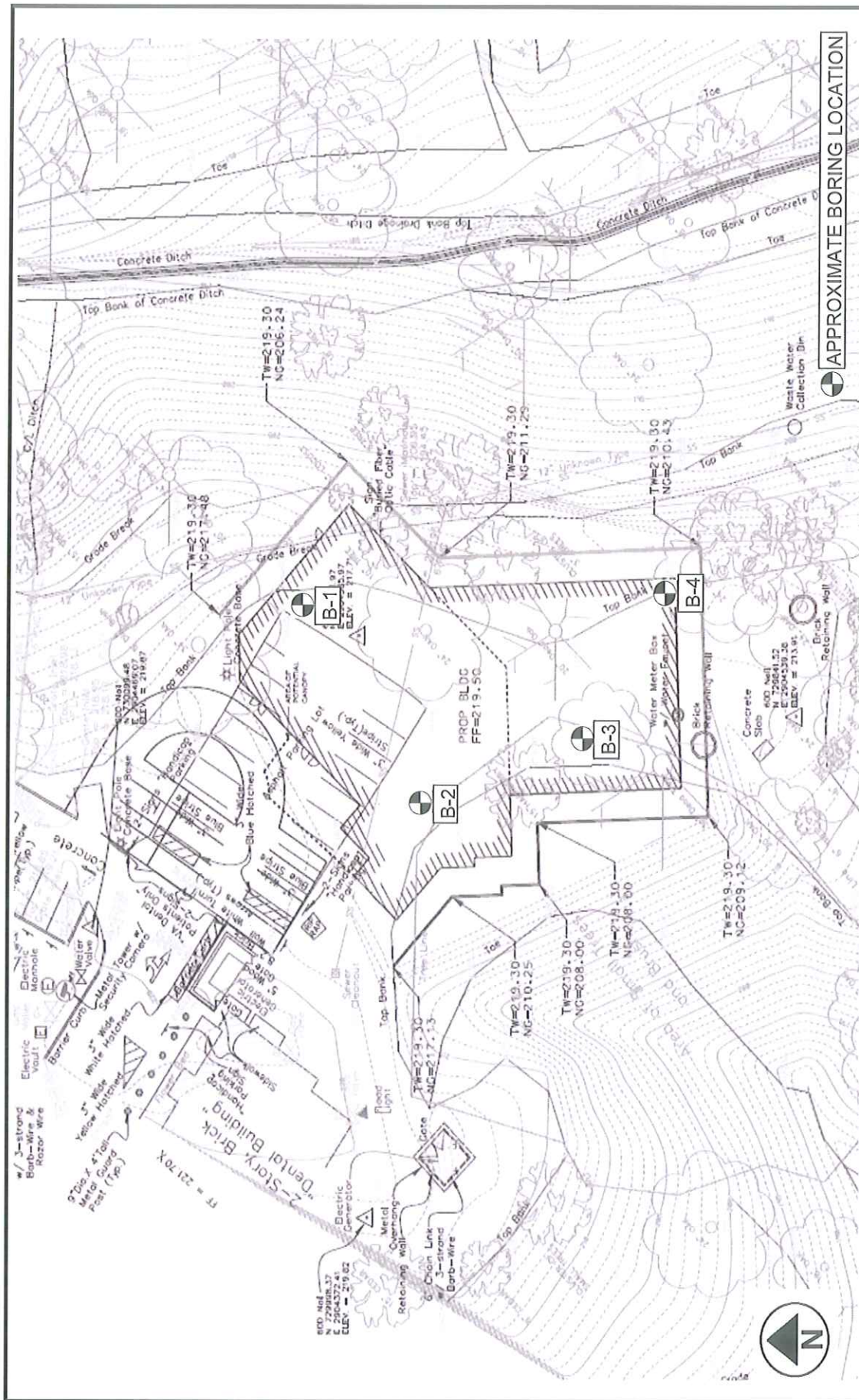
## Site Vicinity Map

Project Name: Cancer Treatment Center  
 Project Location: Overton Brooks VA Medical Center  
 PSI Project #: 02751054  
 Client: SPUR Design  
 Date: March 2015

**PSI** *Information To Build On*  
**Engineering • Consulting • Testing**

4123 Curtis Lane  
 Shreveport, Louisiana 71109





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# LOG OF BORING B-1

Sheet 1 of 1

PSI Job No.: 02751054  
Project: Cancer Treatment Center  
Location: Overton Brooks VA Medical Center  
Shreveport, LA

Drilling Method: Hollow Stem Auger  
Sampling Method: 2-in SS  
Hammer Type: Automatic  
Boring Location:

## WATER LEVELS

While Drilling: None  
Upon Completion: None  
Delay: N/A

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	Station: N/A Offset: N/A	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks	
										STANDARD PENETRATION TEST DATA N in blows/ft @			
										Moisture, %	PL	LL	
										Moisture, %	Qu	Op	
0	0						3 Inches Topsoil						
							Firm Brown Lean Clay (CL)	CL	2-2-4 N=6	18			
								CL	2-2-3 N=5	17		LL = 29 PL = 16	
								CL	1-2-3 N=5	17			
	5						Very Loose Brown Clayey Sand (SC)	SC	1-1-0 N=1	14		Fines=28.2%	
							Hard Gray Lean Clay with silt lenses (CL)	CL	6-19-19 N=38	17		LL = 40 PL = 23	
	10							CL	15-20-27 N=47	11		Fines=97.6%	
	15							CL	11-12-19 N=31	20			
	20						Becoming Very Stiff at 23 Feet	CL	10-11-16 N=27	20			
	25						Boring Terminated at 25 Feet						

Completion Depth: 25.0 ft  
Date Boring Started: 3/8/15  
Date Boring Completed: 3/8/15  
Logged By: H. Jester  
Drilling Contractor: PSI, Inc.

Sample Types:  
Auger Cutting  
Split-Spoon  
Rock Core

Shelby Tube  
Hand Auger  
Calif. Sampler  
Texas Cone




Latitude:  
Longitude:  
Drill Rig: Geoprobe 7822DT ATV  
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

PSI Job No.: 02751054  
Project: Cancer Treatment Center  
Location: Overton Brooks VA Medical Center  
Shreveport, LA

Drilling Method: Hollow Stem Auger  
Sampling Method: 2-in SS  
Hammer Type: Automatic  
Boring Location:

## WATER LEVELS

 While Drilling	None
 Upon Completion	None
 Delay	N/A

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	STANDARD PENETRATION TEST DATA				Additional Remarks
									N in blows/ft				
									Moisture, %				
									X Moisture    PL 0 25 50 STRENGTH, tsf ▲ Qu    * Op				
0						3 Inches Topsoil							
						Firm Brown Lean Clay (CL)	CL	3-2-5 N=7	19				
								4-4-4 N=8	16				LL = 37 PL = 16
						Firm Brown Fat Clay (CH)	CH	3-4-3 N=7	27				LL = 60 PL = 16
						Very Soft Brown Sandy Lean Clay (CL)	CL	2-1-1 N=2	23				Fines=53.2%
						Hard Brown Gray Lean Clay (CL)	CL	7-16-21 N=37	21				
								15-23-26 N=49	12				Fines=98.9%
						Hard Gray Lean Clay with silt lenses (CL)	CL	9-11-17 N=28	20				
								10-10-16 N=26	22				

Completion Depth: 25.0 ft

Date Boring Started: 3/8/15

Date Boring Completed: 3/8/15

Logged By: H. Jester

Drilling Contractor: PSI, Inc.

Sample Types:

Auger Cutting

Split-Spoon

Rock Core

Shelby Tube

Hand Auger

Calif. Sampler

Texas Cone

Latitude:

Longitude:

Drill Rig: Geoprobe 7822DT ATV

Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



Professional Service Industries, Inc.  
4123 Curtis Lane  
Shreveport, LA 71109  
Telephone: (318) 631-5547  
Fax: (318) 631-1546

## LOG OF BORING B-3

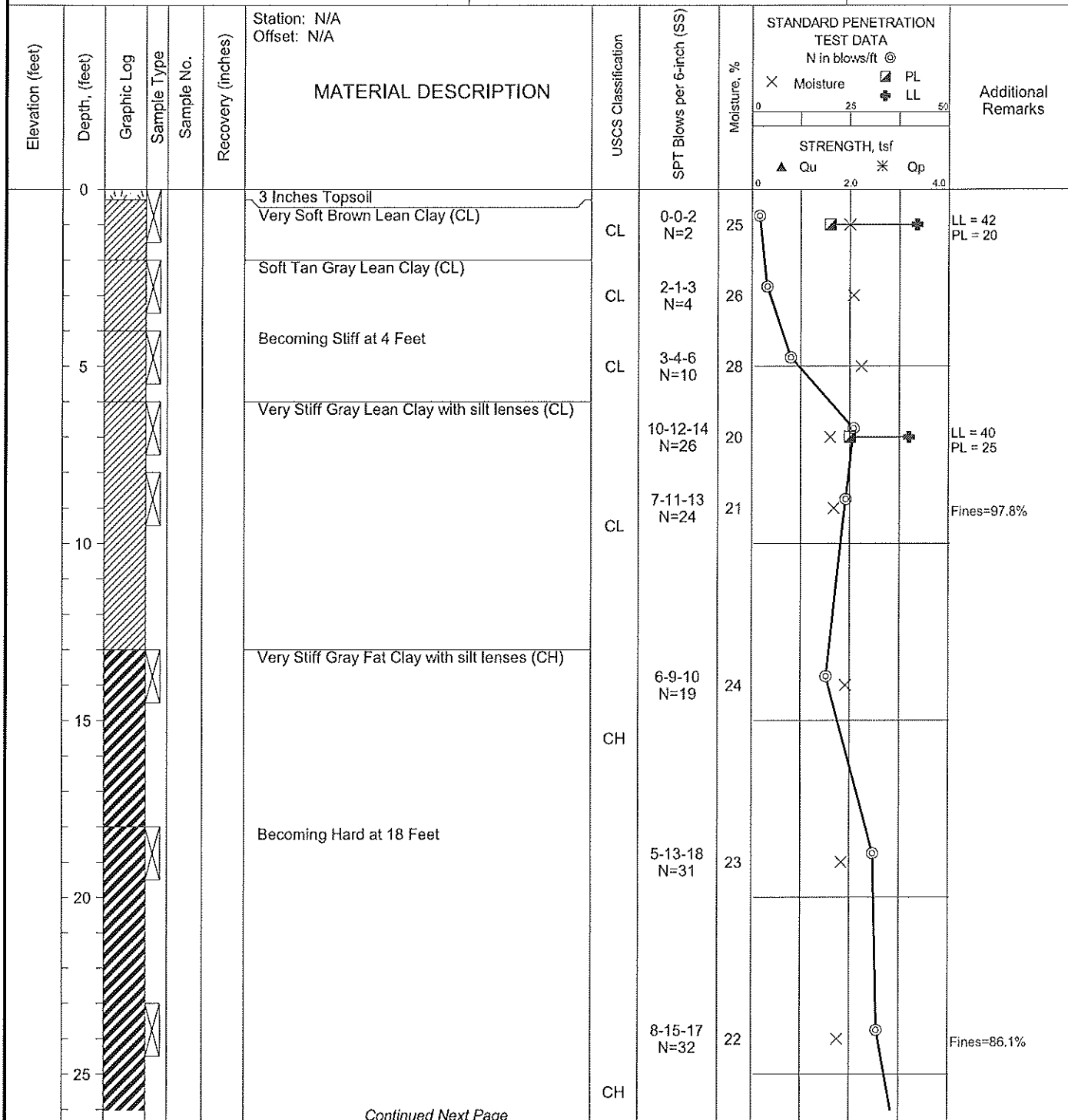
Sheet 1 of 2

PSI Job No.: 02751054  
Project: Cancer Treatment Center  
Location: Overton Brooks VA Medical Center  
Shreveport, LA

Drilling Method: Hollow Stem Auger  
Sampling Method: 2-in SS  
Hammer Type: Automatic  
Boring Location:

### WATER LEVELS

▽ While Drilling None  
▽ Upon Completion None  
▽ Delay N/A



Continued Next Page

Completion Depth: 44.0 ft  
Date Boring Started: 3/9/15  
Date Boring Completed: 3/9/15  
Logged By: H. Jester  
Drilling Contractor: PSI, Inc.

Sample Types:  
Auger Cutting  
Split-Spoon  
Rock Core

Shelby Tube  
Hand Auger  
Calif. Sampler  
Texas Cone

Latitude:  
Longitude:  
Drill Rig: Geoprobe 7822DT ATV  
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



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## LOG OF BORING B-3

Sheet 2 of 2

PSI Job No.: 02751054	Drilling Method: Hollow Stem Auger	<b>WATER LEVELS</b>
Project: Cancer Treatment Center	Sampling Method: 2-in SS	▽ While Drilling None
Location: Overton Brooks VA Medical Center	Hammer Type: Automatic	▼ Upon Completion None
Shreveport, LA	Boring Location:	▼ Delay N/A

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	Station: N/A Offset: N/A	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
											X Moisture    PL LL 0                      25                      50	
							Becoming Hard at 18 Feet				STRENGTH, tsf ▲ Qu    ✱ Qp 0                      2.0                      4.0	
	30								9-15-25 N=40	24		
	35						With Lignite at 33 Feet		16-21-50/4.5" N=71	26		
	40							CH	30-50/3" N=50	20		
									50/5" N=50	21		
							Auger Refusal at 44 Feet					

Completion Depth: 44.0 ft	Sample Types:	Shelby Tube	Latitude:
Date Boring Started: 3/9/15	Auger Cutting	Hand Auger	Longitude:
Date Boring Completed: 3/9/15	Split-Spoon	Calif. Sampler	Drill Rig: Geoprobe 7822DT ATV
Logged By: H. Jester	Rock Core	Texas Cone	Remarks:
Drilling Contractor: PSI, Inc.			

The stratification lines represent approximate boundaries. The transition may be gradual.



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## LOG OF BORING B-4

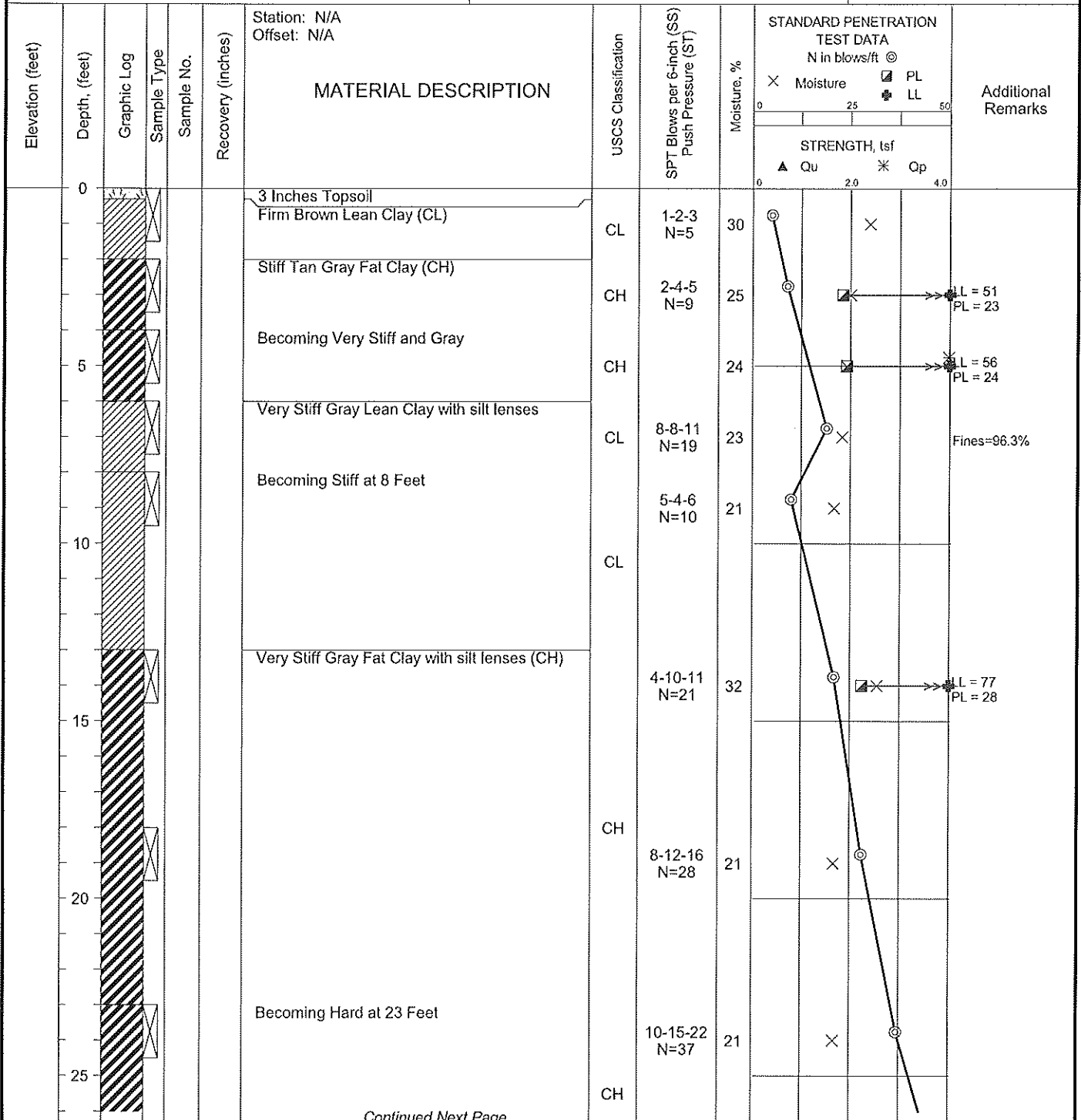
Sheet 1 of 2

PSI Job No.: 02751054  
Project: Cancer Treatment Center  
Location: Overton Brooks VA Medical Center  
Shreveport, LA

Drilling Method: Hollow Stem Auger  
Sampling Method: 2-in SS/3-in ST  
Hammer Type: Automatic  
Boring Location:

### WATER LEVELS

▽ While Drilling None  
▽ Upon Completion None  
▽ Delay N/A



Continued Next Page

Completion Depth: 40.0 ft  
Date Boring Started: 3/6/15  
Date Boring Completed: 3/6/15  
Logged By: H. Jester  
Drilling Contractor: PSI, Inc.

Sample Types:  
Auger Cutting  
Split-Spoon  
Rock Core

Shelby Tube  
Hand Auger  
Calif. Sampler  
Texas Cone

Latitude:  
Longitude:  
Drill Rig: Geoprobe 7822DT ATV  
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



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## LOG OF BORING B-4

Sheet 2 of 2

PSI Job No.: 02751054  
Project: Cancer Treatment Center  
Location: Overton Brooks VA Medical Center  
Shreveport, LA

Drilling Method: Hollow Stem Auger  
Sampling Method: 2-in SS/3-in ST  
Hammer Type: Automatic  
Boring Location:

### WATER LEVELS

▽ While Drilling None  
▽ Upon Completion None  
▽ Delay N/A

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	Station: N/A Offset: N/A	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) Push Pressure (ST)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ©		Additional Remarks
										X Moisture		PL	
										+ LL			
										STRENGTH, tsf			
										▲ Qu	* Op		
							Becoming Hard at 23 Feet						
							With Lignite at 28 Feet		18-50/5" N=50	24			
	30							CH	10-19-29 N=48	17	X		
	35								21-50/5.5" N=50	27	X		
	40						Auger Refusal at 40 Feet						

Moisture, % scale: 0, 25, 50  
STRENGTH, tsf scale: 0, 2.0, 4.0  
SPT Blows per 6-inch (SS) Push Pressure (ST) scale: 0, 25, 50  
Additional Remarks: L = 68, PL = 26

Completion Depth: 40.0 ft  
Date Boring Started: 3/6/15  
Date Boring Completed: 3/6/15  
Logged By: H. Jester  
Drilling Contractor: PSI, Inc.

Sample Types:  
Auger Cutting  
Split-Spoon  
Rock Core  
Shelby Tube  
Hand Auger  
Calif. Sampler  
Texas Cone

Latitude:  
Longitude:  
Drill Rig: Geoprobe 7822DT ATV  
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



## GENERAL NOTES

### SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

### DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.	☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
HSA: Hollow Stem Auger - typically 3 1/4" or 4 1/4" I.D. openings, except where noted.	■ ST: Shelby Tube - 3" O.D., except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry	□ RC: Rock Core
R.C.: Diamond Bit Core Sampler	↓ TC: Texas Cone
H.A.: Hand Auger	☐ BS: Bulk Sample
P.A.: Power Auger - Handheld motorized auger	☒ PM: Pressuremeter
	CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

### SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N <sub>60</sub> : A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q <sub>u</sub> : Unconfined compressive strength, TSF
Q <sub>p</sub> : Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL), %
DD: Dry unit weight, pcf
▽, ▽, ▼ Apparent groundwater level at time noted

### RELATIVE DENSITY OF COARSE-GRAINED SOILS    ANGULARITY OF COARSE-GRAINED PARTICLES

Relative Density	N - Blows/foot	Description	Criteria
Very Loose	0 - 4	Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Loose	4 - 10	Subangular:	Particles are similar to angular description, but have rounded edges
Medium Dense	10 - 30	Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Dense	30 - 50	Rounded:	Particles have smoothly curved sides and no edges
Very Dense	50 - 80		
Extremely Dense	80+		

### GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (3/4 in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to 3/4 in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

### PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

### RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%



## GENERAL NOTES

(Continued)

### CONSISTENCY OF FINE-GRAINED SOILS

<u>Q<sub>u</sub> - TSF</u>	<u>N - Blows/foot</u>	<u>Consistency</u>
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

### MOISTURE CONDITION DESCRIPTION

<u>Description</u>	<u>Criteria</u>
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

### RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

### STRUCTURE DESCRIPTION

<u>Description</u>	<u>Criteria</u>	<u>Description</u>	<u>Criteria</u>
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick	Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick	Lensed:	Inclusion of small pockets of different soils
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing	Layer:	Inclusion greater than 3 inches thick (75 mm)
Slickensided:	Fracture planes appear polished or glossy, sometimes striated	Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
		Parting:	Inclusion less than 1/8-inch (3 mm) thick

### SCALE OF RELATIVE ROCK HARDNESS

<u>Q<sub>u</sub> - TSF</u>	<u>Consistency</u>
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

### ROCK BEDDING THICKNESSES

<u>Description</u>	<u>Criteria</u>
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

### ROCK VOIDS

<u>Voids</u>	<u>Void Diameter</u>
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

### GRAIN-SIZED TERMINOLOGY

<u>(Typically Sedimentary Rock)</u>	
<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

### ROCK QUALITY DESCRIPTION

<u>Rock Mass Description</u>	<u>RQD Value</u>
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

### DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.



# SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS  (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS  MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS  (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS  LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

