RABA KISTNER

GEOTECHNICAL ENGINEERING STUDY

FOR

WESTOVER HILLS HOSPITAL
LOOP 1604 AND WISEMAN ROAD
BEXAR COUNTY, TEXAS

RABA KISTNER

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Project No. ASA21-058-02
June 3, 2022

Kevin Harney, AIA, NCARB
Vice President/Principal
ESa
1033 Demonbreun Street, Suite 800
Nashville, Tennessee 37203

Via email: kevinh@esarch.com

RE: Geotechnical Engineering Study
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

Dear Mr. Harney:

RABA KISTNER, Inc. (RKI) is pleased to submit the report of our Geotechnical Engineering Study for the above-referenced project. This study was performed in accordance with RKI Proposal No. PSA21-108-00a rev 1, dated March 7, 2022. The purpose of this study was to drill borings for proposed the improvements, perform laboratory testing to evaluate subsurface conditions, and to prepare an engineering report presenting foundation recommendations for the proposed structures, as well as to provide pavement design and construction guidelines.

The following report contains our design recommendations and considerations based on our current understanding of the information provided to us. There may be alternatives for value engineering of the foundation systems, and RKI recommends that a meeting be held with the Owner and design team to evaluate these alternatives.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this report, or if we may be of additional assistance with value engineering or on the materials testing-quality control program during construction, please call.

Very truly yours,

RABA KISTNER, INC.

Diego

Diego Neri Garza, E.I.T.
Graduate Engineer

STATE OF TEXAS
ISAAC MOLINA
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LICENSED
PROFESSIONAL ENGINEER

Isaac Molina, P.E.
Project Manager

DN/IM/kv

Attachments

Copies Submitted: Above (1-Electronic)

GEOTECHNICAL ENGINEERING STUDY

For

WESTOVER HILLS HOSPITAL
LOOP 1604 AND WISEMAN ROAD
BEXAR COUNTY, TEXAS

Prepared for

ESA
Nashville, Tennessee

Prepared by

RABA KISTNER, INC.
San Antonio, Texas

PROJECT NO. ASA21-058-

June 3, 2022

RABA KISTNER

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ATTACHMENTS

The following figures are attached and complete this report:

INTRODUCTION

RABA KISTNER Consultants, Inc. (RKI) has completed the authorized subsurface exploration for the proposed improvements to be located south of Wiseman Road and west of Loop 1604 in Bexar County, Texas as illustrated on Figure 1. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendations for foundation design and construction considerations.

PROJECT DESCRIPTION

In general, the project consists of new improvements located on an approximately 66-acre tract of land located south of Wiseman Road and west of Loop 1604 in Bexar County, Texas. The project includes:

- Four-Story Hospital with a partial basement, and with two-story future expansion,
- Four-Story Medical Office Building No. 1 with a partial basement,
- A second Medical Office Building (three location options are being considered at this time),
- Helicopter Pad,
- Retaining Walls to accommodate grade changes across the site,
- Drive Lanes and Associated Parking, and
- Sage Run Roadway to be classified as Arterial per Bexar County and includes a culvert crossing.

Currently, relatively small portions of the site are developed, but a majority of the area appears to be undeveloped and is covered with brush and trees. For the medical office building(s) and hospital, column loads on the order of 550 to 1,450 kips are anticipated, respectively. The lower finished floor elevation for the medical office building and hospital is anticipated to be at El 908 ft msl. The location of the second medical office building has not be set, but three options are being considered. Existing elevations across the site vary from approximately El 944 to 882 ft msl. Based on the provided preliminary grading plans, cuts and fills on the order of 20 ft are anticipated to balance the site. We understand that retaining walls are planned across the site to accommodate the grade changes.

Floor systems consisting of slab-on-ground are expected to be preferred for the lowest level of the structures, provided soil-related, potential vertical movements will not cause structural performance problems. The facilities may also consist of a framed structural slab with a crawl space below the framed floor.

The borings were drilled in the proposed improvement areas as summarized in the following table:

Boring Summary

Associated Borings	Improvement	Existing Elevation (ft, msl)	Finished Floor Elevation (ft, msl)	Depth to Bedrock (ft)
P-1	Proposed Pavements	891	899	2
P-2		890	896	3
P-3		905	905	Less than 1
P-4		888	893	5
P-5		901	903	Less than 1
P-6		909	924	6
P-7		940	939	Less than 1
H-1	Proposed Helicopter Pad	901	923	Less than 1
H-2	Proposed Hospital	892	908	1
H-3		898	908	Less than 1
H-4		898	908	2
H-5		903	908	2
H-6		910	926	2
H-7		919	926	1
H-8		906	908	Less than 1
H-9		922	926	Less than 1
H-10		905	908	1
H-11		912	908	2
H-12		922	926	2
H-13		906	908	1.5
H-14		914	926	1
H-15		902	908	1
H-16		910	926	2
MB1-1	Proposed Medical Office Building No.1	915	908	Less than 1
MB1-2		925	926	1
MB1-3		928	926	Less than 1
MB1-4		929	926	Less than 1
MB1-5		933	926	Less than 1
MB2-1	Proposed Medical Office Building No.2	915	N/A	Less than 1
MB2-2		907	N/A	5
MB2-3		928	N/A	10
MB2-4		934	N/A	1
MB2-5		920	N/A	13.5
MB2-6		919	N/A	1
MB2-7		907	N/A 3	Less than 1

Associated Borings	Improvement	Existing Elevation (ft, msl)	Finished Floor Elevation (ft, msl)	Depth to Bedrock (ft)
RW-1	Proposed Retaining Walls	904	N/A	6
RW-2		898	922	4.5
RW-3		936	928	Less than 1
RW-4		944	931	Greater than 20
RW-5		944	931	Less than 1
RW-6		940	N/A	Greater than 20
RW-7		930	N/A	5
RW-8		922	N/A	Less than 1
SR-1	Proposed Sage Run Roadway	904	N/A	1
SR-2		898	N/A	4.5
SR-3		936	N/A	Less than 1
SR-4		944	N/A	Less than 1
SR-5		910	N/A	1

Lauren Siler, Senior Design Manager, from ES Architecture provided an overall grading and drainage plan created by Pape-Dawson Engineers of the hospital to us on May 23, 2022. This sheet allowed us to obtain the finished floors and existing elevations of the project site.

Note that pavement recommendations for the proposed Sage Run roadway will be provided under a separate cover utilizing Bexar County design methods.

LIMITATIONS

This geotechnical engineering study has been prepared in accordance with accepted Geotechnical Engineering practices in the region of South/Central Texas and for the use of the CLIENT and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses. This report is not intended for use in determining construction means and methods. The attachments and report text should not be used separately.

The recommendations submitted in this report are based on the data obtained from 48 borings drilled at this site, our understanding of the project information provided to us, and the assumption that site grading will result from the grades discussed herein. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our recommendations.

This report may not reflect the actual variations of the subsurface conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. If variations appear evident at the time of construction, it may be necessary to reevaluate our recommendations after performing on-site observations and tests to establish the engineering impact of the variations.

The scope of our Geotechnical Engineering Study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report.

If final grade elevations are significantly different from proposed grades by more than plus or minus 1 ft, our office should be informed about these changes. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.

BORINGS AND LABORATORY TESTS

Subsurface conditions at the site were evaluated by 48 borings drilled at the locations shown on the Boring Location Map, Figure 1. These locations are approximate and distances were measured using a hand-held, recreational-grade GPS locator. Boring elevations, as annotated on the boring logs, were estimated from the provided survey. The borings were drilled to depths ranging from approximately 1 to 55 ft below the existing ground surface using a truck-mounted drilling rig. During drilling operations split-spoon (with standard penetration tests) samples were collected.

Each sample was visually classified in the laboratory by a member of our Geotechnical Engineering staff. The geotechnical engineering properties of the strata were evaluated by the moisture content, percent passing a No. 200 sieve, and Atterberg Limits tests.

The laboratory test results are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 49. A key to classification terms and symbols used on the log is presented on Figure 50. The results of the laboratory and field testing are also tabulated on Figure 51 for ease of reference.

Standard penetration test results are noted as “blows per ft” on the boring logs and Figure 51, where “blows per ft” refers to the number of blows by a falling hammer required for 1 ft of penetration into the soil/weak rock. Where hard or dense materials were encountered, the tests were terminated at 50 blows even if one foot of penetration had not been achieved.

In addition to the above listed testing and sampling, composite bulk samples of anticipated subgrade soils near Boring P-1 was collected for use in the California bearing ratio (CBR) test, pH-lime series, and sulfate content. The results of the moisture-density relationship is presented on Figures 52, respectively.

Dynamic Cone Penetrometer (DCP) tests were also performed in the SR series Borings in the proposed Sage Run Roadway from the existing ground surface to practical equipment refusal. Results are presented on Figure 53.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

GENERAL SITE CONDITIONS

GEOLOGY

A review of the *Geologic Atlas of Texas, San Antonio Sheet*, indicates that this site is naturally underlain with the soils/rock of the Austin Chalk which is a form of limestone with alternating seams of chalky marl and clay. Contains microgranular calcite with foraminifera and other marine fossils. This formation may also contain glauconitic seams and pyrite nodules. Grayish white to white in color. Compared to other limestone formations in the San Antonio area such as Edwards Limestone, the Austin Chalk is comparatively softer in induration but is still considered a very hard rock substance and often contains harder, massive seams, ridges, layers and/or ledges. The Austin Chalk also can contain karstic features in the form of open and/or clay-filled vugs, voids, and/or solution cavities that form as a result of solution movement through fractures in the rock mass.

Key geotechnical engineering considerations for development supported on this formation will be the depth to rock, the expansive nature of the overlying clays, the condition of the rock, and the presence/absence of karstic features.

SEISMIC CONSIDERATIONS

The following information has been summarized for seismic considerations associated with this site per ASCE 7-16 edition.

- Site Class Definition: **Class C**. Based on the soil borings conducted for this investigation and our experience in the area, the upper 100 ft of soil may be characterized as very dense soil and soft rock.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 0.2-Second Spectral Response Acceleration (5% Of Critical Damping): **S_s = 0.049g**. coordinates: 29.257 -98.541
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 1-Second Spectral Response Acceleration (5% Of Critical Damping): **S_1 = 0.020g**.
- Values of Site Coefficient: **F_a = 1.3**
- Values of Site Coefficient: **F_v = 1.5**
- Where g is the acceleration due to gravity.

The Maximum Considered Earthquake Spectral Response Accelerations are as follows:

- 0.2 sec, adjusted: **S_{ms} = 0.064g**
- 1 sec, adjusted: **S_{m1} = 0.03g**

The Design Spectral Response Acceleration Parameters (SA) are as follows:

- 0.2 sec SA: **S_{DS} = 0.043g**
- 1 sec SA: **S_{D1} = 0.02g**

STRATIGRAPHY

The subsurface stratigraphy can generally be described as surficial clay that is underlain by marl or weathered limestone. The soil overburden thickness generally varies from less than 1 ft to depths greater than 20 ft. Additionally, clay seams were noted within the marl and limestone layers.

The boring logs should be consulted for more specific stratigraphic information. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. Unless noted on the boring logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples. The stratification given on the boring logs, or described herein, is for use by RKI in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The boring logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

GROUNDWATER

Groundwater was not observed in the borings either during or immediately upon completion of the drilling operations. However, it is possible for groundwater to exist beneath this site at shallow depths on a transient basis following periods of precipitation and at the natural soil/fill interface or within granular layers. Fluctuations in groundwater levels occur due to variation in rainfall and surface water run-off. The construction process itself may also cause variations in the groundwater level.

FOUNDATION RECOMMENDATIONS

Site features that will influence the geotechnical approach to the proposed project include:

- Potential to encounter groundwater seepage near the soil overburden and granular interface; and
- Potential for mixed bearing conditions;
- Presence of clay seams within the bedrock formation; and
- Depth to bedrock

Please note that the foundation capacities presented herein are based on the Allowable Stress Design methodology. In general, the allowable values given herein for foundations can be increased by 33 percent for seismic, wind or other transitory loads (2018 IBC, Section 1806.1).

EXPANSIVE SOIL-RELATED MOVEMENTS

The anticipated ground movements due to swelling of the underlying soils at the site were estimated for slab-on-grade construction using the empirical procedure, Texas Department of Transportation (TxDOT) Tex-124-E, Method for Determining the Potential Vertical Rise (PVR). In general, PVR values ranging from less than 1 in. to 1-1/4 in. were estimated for the stratigraphic conditions encountered in our borings. A surcharge load of 1 psi (concrete slab and sand layer), an active zone of 15 ft, and dry moisture conditions were assumed in estimating the above PVR values.

To reduce the risk for potential soil-related movements (particularly if the building is surrounded by irrigated landscaped areas), consideration should be given to **completely removing the moderately plastic soils in the area of the proposed hospital and medical office building 1**. If the surficial clays of the previously mentioned buildings is removed and replaced with compacted granular select fill, the PVR will result in less than 1 in. With this consideration, we recommend that all moderately plastic soils be completely removed from within the building footprint of the proposed hospital and medical office building 1 as well as 3 ft around the proposed building areas and the overexcavation backfilled with compacted granular select fill.

To reduce the risk for potential soil-related movements for Medical Office Building 2, if considered, overexcavation and select fill replacement is recommended. Recommendations can be provided once the FFE has been established.

The overexcavated soils may be reused on site, and beyond the building pad, provided that the potential vertical movements in excess of those discussed previously will not adversely impact either the structural or operational tolerances for the proposed improvements for which this material is being considered.

The TxDOT method of estimating expansive soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analysis of expansive soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the calculated PVR values due to isolated changes in moisture content (due to plumbing leaks, landscape watering, etc.) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching or excavations.

Drainage Considerations

Water entering the fill surface during construction or entering the fill exposed beyond the building lines after construction may create problems with fill moisture control during compaction and increased access for moisture to the underlying soils both during and after construction. Several surface and subsurface drainage design features and construction precautions can be used to limit problems associated with fill moisture. These features and precautions may include but are not limited to the following:

- Installing berms or swales on the uphill side of the construction area to divert surface runoff away from the excavation/fill area during construction;
- Sloping the surface of the fill during construction to promote runoff of rain water to drainage features until the final lift is placed;
- Sloping of a final, well maintained, impervious clay or pavement surface (downward away from the building) over the select fill material and any perimeter drain extending beyond the building lines, with a minimum gradient of 6 in. in 5 ft;
- Constructing final surface drainage patterns to prevent ponding and limit surface water infiltration at and around the building perimeter;
- Locating the water-bearing utilities, roof drainage outlets and irrigation spray heads outside of the select fill and perimeter drain boundaries; and
- Raising the elevation of the ground level floor slab.

Details relative to the extent and implementation of these considerations must be evaluated on a project-specific basis by all members of the project design team. Many variables that influence fill drainage considerations may depend on factors that are not fully developed in the early stages of design. For this reason, drainage of the fill should be given consideration at the earliest possible stages of the project.

SHALLOW FOUNDATIONS

In general, the proposed structure may be supported on select fill or natural soils provided the selected foundation type can be designed to withstand the anticipated soil-related movements (see *Expansive Soil-Related Movements*) without impairing either the structural or the operational performance of the structure. The following recommendations are based on the data obtained from current field and laboratory studies, our past experience with geotechnical conditions similar to those at these sites, and our engineering design analyses.

Allowable Bearing Capacity

Shallow foundations bearing on native undisturbed soil or compacted select fill may be proportioned using the parameters tabulated in the following.

Shallow Foundation Design Parameters	
Minimum depth below final grade	18 in.*
Minimum beam or strip footing width	12 in.
Minimum widened beam or spread footing width	18 in.
Maximum net allowable bearing pressure for grade beams/strip footings on compacted select fill	3,000 psf**
Maximum net allowable bearing pressure for widen beams/spread footings on intact bedrock	4,000 psf**

* If intact bedrock is encountered, minimum foundation depth should be discussed with the structural engineer.

** Mixed bearing conditions (i.e. bearing on soil/fill and bedrock) should be avoided to reduce potential for differential settlement.

We do not recommend that the grade beams for an individual structure be founded partially in bedrock and partially in natural soils or compacted fill as this condition may result in greater differential movements. **If mixed bearing conditions are encountered, we recommended that all grade beams either be extended down into the bedrock, or if constructed on a select fill building pad, that a minimum of 1 ft of select fill be placed and compacted beneath the grade beams.**

The above presented maximum allowable bearing pressures will provide a factor of safety of about 3, provided that fill is placed as discussed herein and the subgrade is prepared in accordance with the recommendations outlined in the *Site Preparation* section of this report.

Depending on the structural loads and if higher bearing pressures on bedrock are requested/desired, rock-bearing shallow foundations proportioned for greater than 4,000 psf bearing pressure may require additional probe borings with rock coring or pilot holes at actual foundation locations. Alternatively, the requirement for pilot hole or probe holes may be waived if the bearing pressure provided herein is used. If higher bearing pressures are desired/requested, please contact us to discuss.

The foundation subgrade should be observed by the Geotechnical Engineer or their representative prior to placement of reinforcing steel and concrete. This is necessary to observe that the bearing materials at the bottom of the excavations are similar to those encountered in our borings, that excessive loose materials, mixed bearing conditions, and water are not present in the excavations. If soft soils are encountered in the foundation excavations, they should be removed and replaced with compacted engineered fill material, flowable fill, or lean concrete up to the design foundation bearing elevations.

ISOLATED FOUNDATIONS

Isolated structures may be supported on shallow foundations provided they bear on compacted fill or natural material, provided the selected foundation type can be designed to withstand the anticipated soil-related movements without impairing either the structural or the operational performance of the structure. The specific amount of overexcavation required will depend on the magnitude of movement that can be tolerated. Footings may be proportioned using the allowable bearing pressures presented in the previous section. The size and depth of footings can be adjusted as necessary to resist wind loads. If the potential expansive soil-related movements are excessive for the proposed structures, or if wind loads are greater than what the shallow foundations can resist, then deeper and oversized footings or deep foundations may be considered.

Uplift Resistance

Resistance to vertical force (uplift) is provided by the weight of the concrete footing plus the weight of the soil directly above the footing. For this site, it is recommended that the ultimate uplift resistance be based on total unit weights for soil and concrete of 125 pcf and 150 pcf, respectively. The calculated ultimate uplift resistance should be reduced by a factor of safety of 1.2 to calculate the allowable uplift resistance.

Lateral Resistance

Horizontal loads acting on shallow foundations will be resisted by passive earth pressure acting on one side of the footing and by base adhesion for footings in soil or bedrock. Resistance to sliding for foundations bearing on natural/compacted soil or bedrock may be calculated utilizing an ultimate coefficient of friction of 0.35 or 0.70, respectively. The lateral resistance for these foundations should be limited to 1,225 psf (soil) or 2,800 psf (bedrock). An equivalent fluid pressure of 250 pcf (soil) or 350 pcf (bedrock) may be utilized to determine the ultimate passive resistance, if required.

B.R.A.B. Criteria

Engineered beam and slab foundations are sometimes designed using criteria developed by the Building Research Advisory Board (B.R.A.B.). It should be noted that if the highest plasticity index (PI) value encountered in the subsurface profile occurs in the uppermost subsurface layer, B.R.A.B. criteria requires that this PI value be selected as the design PI. The B.R.A.B. design plasticity index, soil support index (C), Climatic Rating (C_w), and estimated unconfined compressive strength (q_u) presented in the following table may be utilized for the proposed structures.

B.R.A.B. Criteria For Existing Site Conditions	
Climatic Rating, C_w	16
Estimated Unconfined Compressive Strength, q_u	3,150 psf
B.R.A.B. Design Plasticity Index	39
Soil Support Index (C)	0.72

The design criteria will change if a select fill building pad is constructed for the proposed structures. If overexcavation and select fill replacement is performed to reduce the PVR to 1 in. or less, a BRAB design plasticity index (PI) of 20 and a soil support index (C) value of 0.94 may be used.

DEEP FOUNDATIONS

Straight-shaft piers bearing in the underlying marl or limestone strata may be considered. Consequently, pier capacity could be equal to the summation of the following: (1) the end area of the pier multiplied by the allowable end-bearing pressure and (2) the wall area of the pier socket below a depth of 5 ft into the underlying marl or limestone surface area multiplied by the allowable side shear resistance.

Based on the boring information, deep foundation capacities are provided in the following table. The values provided in the following table are based on a factor of safety of 2 (skin friction) and 3 (end-bearing) with respect to the design shear strength. These values may be increased by 1/3 for transient load conditions. Based on the 56 ft maximum depth of exploration, piers should be sized such that the pier bottom does not extend below an elevation of 857 ft below the existing ground surface.

First floor (Main Entry) FFE= 926 ft, msl			
Approximate Depth (ft)	Allowable Skin Friction (ksf)	Allowable End-Bearing (ksf)	Allowable Uplift Resistance for Straight-Shaft Piers (ksf)
926 to 911	N/A	N/A	N/A
911 to 895	1.9	22	1.3
895 to 880	2.7	32	1.8
880 to 857	3.3	40	2.2

Garden Level (Loading Dock) FFE= 908 ft, msl			
Approximate Depth (ft)	Allowable Skin Friction (ksf)	Allowable End-Bearing (ksf)	Allowable Uplift Resistance for Straight-Shaft Piers (ksf)
908 to 892	N/A	N/A	N/A
892 to 880	2.7	32	1.8
880 to 857	3.3	40	2.2

Final shaft depths will be based on interpretation of conditions in the field at the time of construction. If clay seams and/or extremely weathered conditions are encountered within the limestone formation during drilled shaft excavations, the shafts must be extended equal to the thickness of the clay seam/extremely weathered zone to develop the required side shear resistance.

Representatives from RKCI must be present at the time of construction to verify that conditions are similar to those encountered in our borings and that sufficient penetration into the limestone is achieved. For bid purposes, the owner should anticipate that deeper piers will be required in some areas. Consequently, contractors bidding on the job should include unit costs for various depths of additional pier embedment. Unit costs should include those for both greater and lesser depth in both rock and soil. Due to the presence of limestone; high-powered, high-torque drilling equipment should be anticipated for drilled pier construction at this site.

Excavations for grade beams may be performed vertically. In addition, if the grade beams will be excavated in limestone or select fill, carton forms in our opinion are not required, and may bear on the exposed bedrock or select fill.

Pier Shafts Potential Uplift Forces

The pier shafts will be subject to potential uplift forces if the surrounding expansive soils within the active zone are subjected to alternate drying and wetting conditions. The maximum potential uplift force acting on the shaft may be estimated by:

$$F_u = 25*D$$

where:

F_u = uplift force in kips; and
D = diameter of the shaft in feet.

Pier Spacing

We recommend that the foundation elements be spaced at a center-to-center distance of at least three shaft/bell diameters. Such spacing will not require a reduction in the load carrying capacity of the individual foundation elements.

If design and/or construction restraints require that piers be spaced closer than the recommended spacing, RKI must re-evaluate the allowable bearing capacities presented above for the individual piers. Reductions in load carrying capacities may be required depending upon individual loading, spacing conditions, and acceptable settlement.

Lateral Resistance

Resistance to lateral loads and the expected pier behavior under the applied loading conditions will depend not only on subsurface conditions, but also on loading conditions, the pier size, and the engineering properties of the pier. Once pier sizes, concrete strength, and reinforcement are finalized, piers should be analyzed to determine the resulting lateral deflection, maximum bending moment, and ultimate bending moment. This type of analysis is typically performed utilizing a computer analysis program and usually requires a trial and error procedure to appropriately size the piers and meet project tolerances.

To assist the design engineer in this procedure, we are providing the following soil parameters for use in analysis. These parameters are in accordance with the input requirements of one of the more commonly used computer programs for laterally loaded piles, the LPile program. If a different program is used for analysis, different parameters and limitations may be required than what were assumed in selecting the parameters given below. Thus, if a program other than LPile is used, RKI must be notified of the analysis method, so that we can review and revise our recommendations if required. Evaluating the lateral resistance on different pier sizes is outside our scope of work at this time.

The soil-related parameters required for input into the LPile program are summarized in the following table:

First floor (Main Entry) FFE= 926 ft, msl							
Assumed Behavior for Analysis	**Depth (ft)**	**c (psf)**	**k_s (pci)**	**ε_{50}**	**q_u (psi)**	**γ (pcf)**	**γ' (pcf)**
Soft Clay (Matlock)	926 to 921	500	30	0.020	-	120	58
Stiff Clay without Free Water (Reese)	921 to 903	2,580	1,000	0.005	-	120	58
Vuggy Limestone or Marl	903 to 857	-	-	-	1,000	-	78

Garden Level (Loading Dock) FFE= 908 ft, msl							
Assumed Behavior for Analysis	**Depth (ft)**	**c (psf)**	**k_s (pci)**	**ε_{50}**	**q_u (psi)**	**γ (pcf)**	**γ' (pcf)**
Soft Clay (Matlock)	908 to 903	500	30	0.020	-	120	58
Vuggy Limestone or Marl	903 to 857	-	-	-	1,000	-	78

Where: c = undrained cohesion
k_s = p-y modulus (static)
ε_{50} = strain factor
γ = unit weight
γ' = effective unit weight
q_u = Uniaxial Compressive Strength

The parameters presented in the above table do not include factors of safety nor have they been factored. Per the general procedures of Section 1810.3.3.2 of the IBC 2018 edition, the allowable lateral capacity shall not exceed one-half of the lateral load that produces a lateral movement of 1-inch at the ground surface.

It should be noted that where piers are spaced closer than three shaft diameters center to center, a modification factor should be applied to the p-y curves to account for a group effect. We recommend the following p-Multipliers for the corresponding center-to-center pier/pile spacings.

Spacing (shaft diameters)	p-Multiplier
3	1.0
2	0.75
1	0.50

Grade Beams

A positive void space of at least 12 in. should be provided between the soffits of grade beams and the underlying soils for a structurally suspended foundation system.

FLATWORK AND FLOOR SLABS

It should be noted that ground-supported flatwork, as well as buried piping, will be subject to the same magnitude of potential soil-related movements as discussed previously. Thus, where these types of elements abut rigid foundations or isolated structures, differential movements should be anticipated.

For floor slabs and flatwork supported by 6 inches of compacted crushed rock, a subgrade modulus (k-value) of 150 pci may be utilized for slabs constructed for this project. The subgrade modulus may be increased to 250 pci if the floor slabs and flatwork are underlain by at least 2 feet of compacted granular select fill.

Additional floor slab considerations for structures supported by deep foundations are provided in the following. The Owner may select the alternative best satisfying the required performance criteria.

> **Alternative No. 1:** Floor slabs which have high performance criteria or which are movement sensitive in nature should be structurally suspended because of the anticipated ground movements. A positive void space of at least 12 in. should be provided between the slab and the underlying soils. Areas containing critical entry/exit points to the building, such as doorways, should consider using a suspended system to relieve those areas of heave stresses caused by expansive soils.
>
> **Alternative No. 2:** Floor slabs within the superstructure may be ground supported provided the anticipated movements discussed under the *Expansive Soil-Related Movements* section of this report will not impair the performance of the floor, frame, or roof systems.
>
> If differential movements between the slab and the structure are objectionable, soil-supported floor slabs could be dowelled to the perimeter grade beams. Dowelled slabs that are subjected to heaving will typically crack and develop a plastic hinge along a line which will be approximately 5 to 10 ft inside and parallel to the grade beams. Slabs cast independent of the grade beams, interior columns and partitions should experience minimum cracking, but may create difficulties at critical entry points such as doors and may impact interior partitions that are secured to exterior walls.

RETAINING STRUCTURES

The following sections provide information for evaluating lateral earth pressures, backfill compaction, and drainage considerations of earth retaining structures and basement walls.

LATERAL EARTH PRESSURES

Equivalent fluid density values for computation of lateral soil pressures acting on walls were evaluated for various types of backfill materials that may be placed behind the retaining walls. These values, as well as corresponding lateral earth pressure coefficients and estimated unit weights, are presented in the following table.

Back Fill Type	Estimated Total Unit Weight (pcf)	Active Condition		At-Rest Condition	
		Earth Pressure Coefficient, k_a	Equivalent Fluid Density (pcf)	Earth Pressure Coefficient, k_o	Equivalent Fluid Density (pcf)
Washed Gravel	135	0.29	40	0.45	60
Crushed Limestone	145	0.24	35	0.38	55
Clean Sand	120	0.33	40	0.5	60
Pit Run Clayey Gravels or Sands	135	0.32	45	0.48	65
Inorganic Clays of Low to Medium Plasticity (Liquid Limit less than 40 percent)	120	0.40	50	0.55	65
Onsite Soil	120	0.59	70	0.74	90

The values tabulated above under “Active Conditions” pertain to flexible retaining walls free to tilt outward as a result of lateral earth pressures. For rigid, non-yielding walls the values under “At-Rest Conditions” should be used.

The “At-Rest” condition is present when the wall is not allowed to move. Once the wall moves outward a short distance, it relieves part of the horizontal stress. The horizontal movement required to reach the active condition may be estimated by using 0.01*H (where H is the wall height). For example, for a 10 ft. tall wall, horizontal movements up to 1.2 inches may be required to develop the active condition. Once the soil attains the active condition, the horizontal stress in the soil (and thus the pressure acting on the wall) will be reduced. **Features/structures directly behind the wall, designed using the Active Condition, may experience settlements similar to the horizontal movements.** Where these types of movements are objectionable, the retaining wall should be designed using At-Rest Conditions.

For the provided values to be valid for sand or gravel backfill, the backfill should be placed in a wedge extending upward and away from the edge of the wall at a 45-degree angle or flatter. If sand and gravel are to be placed within a steeper wedge, the values for Pit Run Gravels/Sands, or Inorganic Clays provided above should be used. Further, any soft soil on the excavation slope should be removed prior to placement of backfill.

The values presented above assume the surface of the backfill materials to be level. Sloping the surface of the backfill materials will increase the surcharge load acting on the structures. The above values also do not include the effect of surcharge loads such as loading from construction equipment, vehicular loads (such as 250 psf), future storage near the structures or other loading/surcharge conditions. Nor do the values account for possible hydrostatic pressures resulting from groundwater seepage entering and ponding within the backfill materials. However, these surcharge loads and groundwater pressures should be considered in designing any structures subjected to lateral earth pressures.

The onsite soils exhibit significant shrink/swell characteristics. **The use of onsite expansive soil as backfill against the proposed retaining structures is not recommended.** Expansive soils generally provide higher design active earthen pressures, as indicated above, but may also exert additional active pressures associated with swelling. Controlling the moisture and density of these materials during placement will help reduce the likelihood and magnitude of future active pressures due to swelling, but this is no guarantee.

Wall Backfill Compaction

Placement and compaction of backfill behind the walls will be critical, particularly at locations where backfill will support adjacent near-grade foundations and/or flatwork. If the backfill is not properly compacted in these areas, the adjacent foundations/flatwork can be subject to settlement.

To reduce potential settlement of adjacent foundations/flatwork, the backfill materials should be placed and compacted as recommended in the *Select Fill* section of this report. Each lift or layer of the backfill should be tested during the backfilling operations to document the degree of compaction. Within at least a 5-ft zone of the wall backside, we recommend that compaction be accomplished using hand-guided compaction equipment capable of achieving the maximum density in a series of 3 to 5 passes. Thinner lifts may be required to achieve compaction.

Drainage

The use of drainage systems is a positive design step toward reducing the possibility of hydrostatic pressure acting against the retaining structures. Drainage may be provided by the use of a drain trench and pipe. The drain pipe should consist of a slotted, heavy duty, corrugated polyethylene pipe and should be installed and bedded according to the manufacturer's recommendations. The drain trench should be filled with gravel (meeting the requirements of ASTM D 448 coarse concrete aggregate Size No. 57 or 67) and extend from the base of the structure to within 2 ft of the top of the structure. The bottom of the drain trench will provide an envelope of gravel around the pipe with minimum dimensions consistent with the pipe manufacturer's recommendations. The gravel should be wrapped with a suitable geotextile fabric (such as Mirafi 140N or equivalent) to help minimize the intrusion of fine-grained soil particles into the drain system. The pipe should be sloped and equipped with clean-out access fittings consistent with state-of-the-practice plumbing procedures.

As an alternative to a full-height gravel drain trench behind the proposed retaining structures, consideration may be given to utilizing a manufactured geosynthetic material for wall drainage. A number of products are available to control hydrostatic pressures acting on earth retaining structures, including Amerdrain (manufactured by American Wick Drain Corp.), Miradrain (manufactured by Mirafi, Inc.), Enkadrain (manufactured by American Enka Company), and Geotech Insulated Drainage Panel (manufactured by Geotech Systems Corp.). The geosynthetics are placed directly against the retaining structures and are hydraulically connected to the gravel envelope located at the base of the structures.

Weepholes may be considered along the length of the proposed basement structures, if desired, in addition to one of the two alternative drainage measures presented above. Based on our experience, weepholes, as the only drainage measure, often become clogged with time and do not provide the required level of drainage from behind retaining structures.

Waterproofing

Consideration may also be given to applying waterproofing coatings to any below-grade structures. Waterproofing for capillary moisture is often accomplished by painting the wall exteriors with a bituminous material. For greater seepage protection, waterproofing would be recommended. Raba Kistner can provide Building Envelope services as necessary.

RETAINING WALL FOOTINGS

Footings may be designed using the parameters provided in the section titled *Allowable Bearing Capacity.* To reduce the potential for differential settlement, we recommend extending the retaining wall foundations down to similar bearing material.

VERTICAL ROCK CUTS

The project site is primarily underlain by the Austin Chalk formation. Where competent limestone bedrock is exposed, cuts into this material may be performed vertically. However, depending on the condition of the limestone at the face of any vertical cut slope stabilization may be required. It is common for cuts into this formation to encounter layers of alternating resistance with the exposed limestone being subject to alternating weathering. The limestone bedrock can also exhibit a characteristic mode of slope failure known as raveling. This failure mechanism involves raveling of the rock/other material along fractures, bedding planes, seams, and other pre-existing planes of weakness, resulting in the separation of blocks, weathered material or soil. Cobble- to boulder-sized blocks will eventually become dislodged as the result of this process and fall from the cut wall. The raveling process can be exacerbated by the presence of existing dissolution or weathered features in the rock, and by discharge of perched groundwater, if any, through the face of the rock cut.

Owing to increased moisture conditions typically associated with fractures, tree roots and other vegetation tend to exploit these weaknesses in the rock outcrop and serve to enhance the rate of erosion. As tree roots, etc. proliferate through fractures, fractures are enlarged owing to both mechanical and chemical erosional processes. Raveling failures can be expected to occur more frequently when these conditions occur.

In some instances, near-vertical rock slopes or cuts can be unprotected and unsupported provided that an adequate catchment area or buffer area is provided at the toe to prevent rockfall from affecting adjacent improvements. A flat catchment area should be at least 0.5 times the height in width. In areas where adequate catchment cannot be provided due to right-of-way or other geometrical constraints, the slope should be protected from raveling and differential erosion, or laid back at a 1 Vertical to 1 Horizontal slope, or flatter. In addition to these protective measures, seepage and surface water control to prevent stormwater from flowing over and down the face of the cut are essential in minimizing raveling and erosion.

For fixed-head walls that may be formed against the exposed competent limestone bedrock, we recommend that the following lateral pressure be used:

$$p_h = 45h + 0.3q \text{ (for fixed-head walls)}$$

Where:

p_h = lateral pressure at any depth h, psf
h = depth below adjacent grade, feet
q = surcharge loads, psf

The above equation does not account for hydrostatic pressures. The walls should be designed to withstand the hydrostatic pressures and/or designed with a drainage system.

FOUNDATION CONSTRUCTION CONSIDERATIONS

SITE DRAINAGE

Drainage is an important key to the successful performance of any foundation. Good surface drainage should be established prior to and maintained after construction to help prevent water from ponding within or adjacent to the building foundation and to facilitate rapid drainage away from the building foundation. Failure to provide positive drainage away from the structure can result in localized differential vertical movements in shallow supported foundations and floor slabs (which can in turn result in cracking in the sheetrock partition walls and shifting of ceiling tiles, as well as improper operation of windows and doors).

Current ordinances, in compliance with the Americans with Disabilities Act (ADA), may dictate maximum slopes for walks and drives around and into new buildings. These slope requirements can result in drainage problems for buildings supported on expansive soils. We recommend that, on all sides of the building, the maximum permissible slope be provided away from the building.

Also to help control drainage in the vicinity of the structure, we recommend that roof/gutter downspouts and landscaping irrigation systems not be located adjacent to the building foundation. Where a select fill overbuild is provided outside of the floor slab/foundation footprint, the surface should be sealed with an impermeable layer (pavement or, geomembrane, or clay cap) to reduce infiltration of both irrigation and surface waters. Careful consideration should also be given to the location of water bearing utilities, as well as to provisions for drainage in the event of leaks in water bearing utilities. All leaks should be immediately repaired.

SITE PREPARATION

Building areas and all areas to support select fill should be stripped of all vegetation, organic topsoil, existing fill, if any, pavements, utilities and associated backfill. Furthermore, as discussed in a previous section of this report, if a ground-supported floor system is selected, we recommend that one of the PVR reduction options be utilized to reduce expansive soil-related movements to within acceptable structural and operational tolerances, or structurally suspended. It will be of critical to plug any utilities and associated utility backfill that extend into the overexcavation to reduce the chances of shallow moisture migration into the select fill pad materials following construction of these improvements.

Exposed subgrades should be thoroughly proofrolled in order to locate weak, compressible zones. A fully-loaded tandem wheeled dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. Proofrolling operations should be observed by the Geotechnical Engineer or their representative to document subgrade condition and preparation. Weak or soft areas identified during proofrolling should be removed and replaced with suitable, compacted engineered fill, free of organics, oversized materials, and degradable or deleterious materials.

Upon completion of the proofrolling operations and just prior to fill placement or slab construction, the exposed subgrade should be moisture conditioned by scarifying to a minimum depth of 6 in. and recompacting to a minimum of 95 percent of the maximum dry density determined from TxDOT, Tex-114-E or ASTM D698, Compaction Test. The moisture content of the subgrade should be maintained within the range of optimum moisture content to 3 percentage points above optimum moisture content until permanently covered.

ONSITE SOIL AND FILL

The use of onsite soils may be a considered for general fill (outside of the structure footprints), if the potential vertical movements in excess of those discussed previously will not adversely impact either the structural or operational tolerances for the proposed improvements for which this material is being considered.

SELECT FILL

Potentially expansive clays (PI greater than 20) should **not** be used as select fill in the building pad unless the clay is treated with lime or cement to reduce the plasticity index. The native untreated soils may be used as general fill beyond the building footprint in areas where potential vertical movements will not adversely impact either the structural or operational tolerances for the individual foundations, slabs or walls for which this material is being considered. Consideration may be given to using some of the plastic soil in areas where soil-related movements will not be objectionable (i.e. green spaces).

To reduce expansive soil-related movements in at-grade construction, the expansive clays in the building area can be removed by overexcavating and backfilling with a suitable select fill material. Recommendations for imported granular select fill building pad materials are provided in the following:

Imported Crushed Limestone Base – Imported crushed limestone base materials should be should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 247, Flexible Base, Type A or B, Grades 1-2 or 3.

Recycled Concrete – The re-use of processed concrete materials may be considered as a suitable fill material. These materials can be considered as a way to reduce the costs of construction materials. Demolition rubble may be used as fill if deleterious materials can be separated. Oversized rubble should be processed to a well-graded material (similar to TxDOT, Tex-247 for Type A or B, Grades 1-2 or 3) with a maximum particle size of 4 inches (the larger material should be restricted where footing and utility excavations are planned). Rubble larger than 4 inches in any dimension should be discarded or processed to the maximum dimension. Care should be taken when placing the rubble fill that the larger pieces are not concentrated in a manner such that voids develop between nested pieces; a sufficient quantity of fines should be provided to reduce this risk.

Alternative select fill materials consist of the following:

Granular Pit Run Materials – Granular pit run materials should consist of GC, SC & combination soils (clayey gravels), as classified according to the Unified Soil Classification System (USCS). Alternative select fill materials shall have a maximum liquid limit not exceeding 40, a plasticity index between 7 and 20, and a maximum particle size not exceeding 4 inch. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with pit-run materials.

Low PI Materials – Low PI materials should consist of lean clays, as classified according to the Unified Soil Classification System (USCS). Alternative select fill materials shall have a maximum liquid limit not exceeding 40, a plasticity index between 7 and 20, and a maximum particle size not exceeding 4 inch. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with these materials.

If the above-listed materials or alternative select fills are being considered for bidding purposes, the materials should be submitted to the Geotechnical Engineer for evaluation at a minimum of 10 working days or more prior to the bid date. Failure to do so will be the responsibility of the contractor. The contractor will also be responsible for ensuring that the properties of all delivered alternate select fill materials are similar to those of the pre-approved submittal**. It should also be noted that when using alternative fill materials such as *Granular Pit Run or Low PI Materials*, difficulties may be experienced with respect to moisture control during and subsequent to fill placement, as well as with erosion, particularly when exposed to inclement weather. This may result in sloughing of beam trenches and/or pumping of the fill materials.**

Granular Pit Run or Low PI Materials will be very susceptible to small changes in moisture content and to disturbance from foot traffic during the placement of steel reinforcement in beam trenches, particularly in periods of inclement weather. Disturbance from such foot traffic and from the accumulation of excess water can result in losses in bearing capacity and increased settlement. If inclement weather is anticipated at the time construction, consideration should be given to protecting the bottom of foundation excavations by placing a thin mud mat (layer of flowable fill or lean concrete) at the bottom of trenches immediately following excavation. This will reduce disturbance from foot traffic and will impede the infiltration of surface water. The side slopes of beam trench excavations may also need to be flattened to reduce sloughing in cohesionless soils. All necessary precautions should be implemented to protect open excavations from the accumulation of surface water runoff and rain.

Soils classified as CH, MH, ML, SM, GM, OH, OL and Pt under the USCS are not considered suitable for use as select fill materials at this site.

Select Fill Placement and Compaction

Select fill should be placed in loose lifts not exceeding 8 in. in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-113-E, Compaction Test, or 98 percent of maximum density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content until final compaction for imported crushed limestone base. For low PI materials, the moisture content of the fill should be maintained within the range of optimum to plus 3 percentage points above the optimum moisture content until final compaction.

General Fill Placement and Compaction

The remaining fill (such as parking lot areas or green spaces) may be compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the fill should be maintained within the range of optimum to plus 3 percentage points above the optimum moisture content until final compaction.

DRILLED PIERS

Each drilled pier excavation must be examined by an RKI representative who is familiar with the geotechnical aspects of the soil stratigraphy, the structural configuration, foundation design details and assumptions, prior to placing concrete. This is to observe that:

- The shaft has been excavated to the specified dimensions at the correct depth established by the previously mentioned criteria;
- The shaft has been drilled plumb within specified tolerances along its total length; and
- Excessive cuttings, buildup and soft, compressible materials have been removed from the bottom of the excavation.

Reinforcement and Concrete Placement

Reinforcing steel should be checked for size and placement prior to concrete placement. Placement of concrete should be accomplished as soon as possible after excavation to reduce changes in the moisture content or the state of stress of the foundation materials. No foundation element should be left open overnight without concreting.

Temporary Casing

Although not observed in our borings, groundwater seepage and/or side sloughing may be encountered at the time of construction, specifically at the soil/marl interface and sandy/gravelly layers, depending on climatic conditions prevalent at the time of construction. Therefore, we recommend that the bid documents require the foundation contractor to specify unit costs for different lengths of casing that may be required.

EXCAVATION SLOPING AND BENCHING

If utility trenches or other excavations extend to or below a depth of 5 ft below construction grade, the contractor or others shall be required to develop a trench safety plan to protect personnel entering the trench or trench vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, are beyond the scope of the current study. Any such designs and safety plans shall be developed in accordance with current OSHA guidelines and other applicable industry standards.

EXCAVATION EQUIPMENT

Our boring logs are not intended for use in determining construction means and methods and may therefore be misleading if used for that purpose. We recommend that earth-work and utility contractors interested in bidding on the work perform their own tests in the form of test pits to determine the quantities of the different materials to be excavated, as well as the preferred excavation methods and equipment for this site.

CRAWL SPACE CONSIDERATIONS

If the structurally suspended floor system described as Alternative No. 1 under the *Floor Slab* section of this report is selected, several special design issues should be considered for the resulting subfloor crawl space. These issues are discussed below.

Ventilation

Observations by members of our firm of open crawl spaces have indicated a need for adequate subfloor ventilation. Such ventilation helps promote evaporation of subgrade moisture which may accumulate in spite of special surface and subsurface drainage features. As a minimum, free flowing passive vents may need to be installed along the perimeter beam to provide cross ventilation. If structural configurations will limit the free flow of air through passive vents, forced air, power vents should be installed. All vents should be designed such that they will not allow the drainage of surface water into the crawl space.

Below Slab Utilities

A minimum clearance of 6 in. has been recommended between both the grade beams and floor slab and the underlying finished subgrade should a suspended floor system be employed for any grade level slab. Such a minimum clearance is also recommended between the subgrade and any utilities which may be suspended from the underside of the floor. This clearance will allow swell-related subgrade movements without damaging the utilities. It is recommended that the utility clearance not be provided by the addition of narrow trenches running parallel to and immediately below the utilities, unless proper slopes and drainage outlets are provided to prevent ponding of water in the trenches.

Drainage

As discussed throughout this report, positive drainage is a key factor in the long term performance of any foundation. This is not only critical around the perimeter of the structure, but also in any subfloor crawl spaces. In crawl areas, surface drainage should be established that will direct water away from and will prevent water from ponding adjacent to piers. This positive drainage should be maintained both prior to and after construction.

Compaction control of the backfill around the perimeter of the building following the placement of soil retainer blocks is critical to the drainage away from the building following construction. Materials for the backfill around the perimeter of the building should be the on-site clays. These materials should be compacted in uniformly thin lifts (8-inch maximum loose thickness) to at least 90 percent of the maximum dry density as determined by TxDOT Test Method TEX-114-E, or ASTM D698. These clays should be placed and compacted at optimum to plus 3 percent above optimum moisture content. Compaction by hand operated mechanical tampers will help to avoid damage to the soil retainer blocks. Following backfilling operations the soil retainer blocks should be checked to see that they have not been broken or collapsed during the compaction operations. Any soil retainer blocks that are broken or collapsed should be repaired or replaced.

Carton Forms

When carton forms are used to form subfloor void spaces, the forms often get wet or sometimes absorb water from humid air. This can result in collapse of the forms during the placement of concrete, thus diminishing the design void space. Conversely, if the carton forms are too strong and do not decompose sufficiently with time, they may not collapse as soil heave occurs, resulting in heave damage to the floor slab. Where there is sufficient moisture to cause the appropriate deterioration after construction, there may be a resulting moisture problem in the floor slab as a result of poor ventilation and the accumulation of condensation within the resulting unventilated void space. The lack of ventilation may also result in increased soil movements that will diminish the design void space. For these reasons, we recommend that where possible, consideration be given to methods other than the use of carton forms to form the recommended void space beneath floor slabs. If project specifics require the use of carton forms, then as a minimum, care should be taken to ensure that the carton forms are designed for use in the project location, and that carton forms are properly stored, protected, and installed during construction.

INTERIOR WALLS

It is not uncommon for cracking to occur in interior partition walls that are supported by a “floating” floor slab and structurally tied to either an interior column or an exterior wall supported by deep foundations. This should be taken into account during the design phase of the project if a “floating” slab foundation is used to support the proposed building.

UTILITIES

Utilities which project through slab-on-grade, slab-on-fill, “floating” floor slabs, or any other rigid unit should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce the risk of damage to the utility lines as vertical movements occur. These types of slabs will generally be constructed as monolithic, grid type beam and slab foundations or as a “floating” floor slab described as Alternative No. 2 under the *Floor Slab* section of this report.

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches (such as fractures within a rock mass or at contacts between rock and clay formations). It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- All backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and all backfilling procedures should be tested and documented.
- Curbs should completely penetrate base materials and be installed to a sufficient depth to reduce water infiltration beneath the curbs into the pavement base materials.
-

Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

PAVEMENT RECOMMENDATIONS

We understand pavement recommendations were requested for Westover Hills Baptist Hospital. Recommendations for both flexible and rigid pavements are presented in this report. The Owner and/or design team may select either pavement type depending on the performance criteria established for the project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more "forgiving", and therefore tend to be more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have a significant impact on long term performance, particularly where permeable base materials are utilized in the pavement section. Drainage considerations are discussed in more detail in a subsequent section of this report.

SUBGRADE CONDITIONS

We have assumed the subgrade in pavement areas will consist of the recompacted onsite soils, placed and compacted as recommended in the *Onsite Soil Fill* section of this report. Based on the DCP test results and our experience with similar subgrade soils, we have assigned a California Bearing Ratio (CBR) value of 4.0 for use in pavement thickness design analyses.

DESIGN INFORMATION

The pavement section recommendations were prepared using the 1993 “Guide for the Design of Pavement Structures” by the American Association of State Highway and Transportation Officials (AASHTO). We have based our analysis on the following design parameters. **The Project Civil Engineer should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility.**

Pavement Design Parameters	Flexible Pavement	Rigid Pavement
Performance Period	20 yrs	
Design Traffic, 18-kip ESALs Light Duty Heavy Duty	50,000(1) 176,000(2)	113,300(3) 310,400(4)
California Bearing Ratio (CBR)	4.0(5)	
Initial Serviceability Index	4.2	4.5
Terminal Serviceability Index	2.0	
Overall Standard Deviation	0.45	0.35
Reliability	70%	
Modulus of Subgrade reaction (k-value)	-	120 pci
28-day Concrete Modulus of Rupture	-	550 psi
28-day Concrete Elastic Modulus	-	4,000,000 psi
Load Transfer Coefficient	-	3.7

Pavement Design Parameters	Flexible Pavement	Rigid Pavement
Drainage Coefficient	-	1.0
Roadbed Soil Resilient Modulus	6,000 psi	-

(1) Approximately equivalent to 2 tractor-trailer trucks per day.
(2) Approximately equivalent to 10 tractor-trailer trucks per day.
(3) Approximately equivalent to 3 tractor-trailer trucks per day.
(4) Approximately equivalent to 10 tractor-trailer trucks per day.
(5) The CBR was assigned based on our laboratory CBR test result.

Note that Sage Run pavement recommendations will be provided under a separate cover utilizing Bexar County design standards and specifications.

RECOMMENDED PAVEMENT SECTIONS

Pavement sections recommended for this site are as listed in the table below. Alternative sections can be provided upon request.

Pavement Type	Flexible Pavement[2]				Rigid Pavement	
Traffic	Light Duty		Heavy Duty		Light Duty	Heavy Duty
Portland Cement Concrete (in.)	-		-		5	6
Asphaltic Concrete Surface Course (in.)	2		3		-	-
Flexible (Granular) Base (in.)	8	7	8	7	-	-
Geogrid (Tensar TX-5 or Approved Substitute)	No	Yes	No	Yes	-	-
Lime/cement Treated Subgrade (in.) [1]	6[1]		6[1]		6[1]	6[1]

(1) Used as a working or construction platform only, **if constructed on soil subgrades**, and considered as an **option**. Note that treatment will not be possible for areas with subgrade consisting of bedrock.
(2) Other pavement sections are available and can be provided upon request.

RIGID PAVEMENT CONSIDERATION

We recommend Jointed Plain Concrete Pavement (JPCP) be utilized for the rigid pavement sections. JPCP typically does not require distributed steel, micro- or macro-fibers, or any other “reinforcing” material. The following recommendations are based on ACI 330R-08 “Guide for the Design and Construction of Concrete Parking Lots.”

Typical joint types in JPCP include: control (contraction) joints, isolation joints (sometimes called expansion joints), and construction joints. The recommended joint spacing is 30 times the thickness of the slab up to a maximum of 15 ft. The length of a slab or panel should not be more than 25% greater than its width. For pavements with a thickness of 7 in. or greater, if any, dowels may be required along all control joints. Tie bars may be required at the first longitudinal joint from the pavement edge to keep the outside edge from separating from the pavement.

Isolation joints are used to separate concrete slabs from other structures or fixed objects within or abutting the paved area to offset the effects of expected differential horizontal and vertical movements. Such structures include, but are not limited to, buildings, light standard foundations, and drop inlets. Isolation joints are also used at "T" intersections to accommodate differential movement along the different axes. Isolations joints are sometimes referred to as expansion joints. However, they are rarely needed to accommodate concrete expansion so they are not typically recommended for use as regularly spaced joints.

We recommend a jointing layout plan be established and reviewed by all parties prior to construction. We also recommend avoiding jointing lines which create angles of less than 60 degrees, "T" joints, and interior corners.

Proper curing of the concrete pavement should be initiated immediately after finishing. All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab and should extend completely through monolithic curbs (if used). Sawing of control joints should begin as soon as the concrete will not ravel, preferably within 1 to 3 hours using an early entry saw or 4 to 8 hours with a conventional saw. Timing will be dictated by site conditions.

FLEXIBLE PAVEMENT CONSIDERATION

Based on our experience, the reported flexible pavement sections often perform adequately; however, maintenance or an overlay is generally needed sooner than would be required for a thicker design section. Consideration could be given to adding additional asphalt (i.e. an additional 1 in.) or incorporating a geogrid below the flexible base. **In our opinion, incorporating geogrid into the pavement section will enhance overall pavement performance and reduce the potential for cracking and maintenance in asphalt pavements.**

Another option to help reduce the potential for cracking and maintenance in asphalt pavements is including reinforcing fibers, such as Forta-Fi®, into the Hot Mix Asphalt (HMA). This is an option and is not required. We recommend that the geogrid reinforcement be Tensar TX-5, or an approved substitute.

Garbage Dumpsters

Where flexible pavements are constructed at any site, we recommend that reinforced concrete pads be provided in front of and beneath trash receptacles. Concrete pads at this site should be a minimum of 6 in. thick. The dumpster trucks, should be parked on the rigid pavement when the receptacles are lifted.

CONSIDERATIONS FOR TRANSITIONS FROM RIGID TO FLEXIBLE PAVEMENTS

At rigid to flexible pavement transitions, we recommend that special attention be given to designing an appropriate transition from the proposed asphalt flexible pavement to the rigid concrete pavement. This transition detail should be developed to help minimize the amount of movement at the transition and possible faulting or widening the joint. The transition may include constructing a concrete sleeper/approach slab below the flexible pavement section or using full depth asphalt pavement section adjacent to the concrete pavement the total thickness of the adjacent asphalt and flexible base section.

FIRE LANE

Based on available literature, a 75,000 pound fire truck will impart approximately 6.9 ESALs per pass. Therefore, the proposed pavement sections provided herein will be able to support occasional fire truck traffic.

PAVEMENT CONSTRUCTION CONSIDERATIONS

SUBGRADE PREPARATION

Areas to support pavements should be prepared in accordance with the recommendations in the *Site Preparation* section under *Foundation Construction Considerations*.

DRAINAGE CONSIDERATIONS

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage which allows saturation of the pavement subgrade and/or the supporting granular pavement materials will greatly reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

1) Any known natural or man-made subsurface seepage at the site which may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.
2) Final site grading should eliminate isolated depressions adjacent to curbs which may allow surface water to pond and infiltrate into the underlying soils. **Curbs should completely penetrate base materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs**.
3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

ON-SITE SOIL FILL

As discussed previously, the pavement recommendations presented in this report were prepared assuming that on-site soils will be used for fill grading in proposed pavement areas. If used, we recommend that on-site soils be placed in loose lifts not exceeding 8 in. in thickness and be compacted to at least 95 percent of maximum dry density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the fill should be maintained within the range of optimum to 3 percentage points above the optimum water content until permanently covered. We recommend that fill materials be free of roots and other organic or degradable material. We also recommend that the maximum particle size not exceed 4 in. or one half the lift thickness, whichever is smaller.

TREATMENT OF SUBGRADE

The soils at this site are plastic and can be difficult to work with, particularly during periods of inclement weather. To provide a suitable, weather-resistant working surface for construction activity, the upper 6 to 8 in. of the highly plastic subgrade clays may be treated with hydrated lime or Portland cement. This is an **option** and is **not** required as part of the pavement thickness design presented above. We do not recommend that the lime or cement-treated subgrade be considered as a structural pavement component.

Lime or cement treatment of the subgrade soils, if utilized, should be in accordance with the TxDOT Standard Specifications, Item 260 or Item 275 as applicable. A sufficient quantity of hydrated lime or cement should be mixed with the subgrade soils to reduce the soil plasticity index to 20 or less. For estimating purposes, the dosage rate for hydrated lime or cement treatment may be applied at 3 percent of the soil dry unit weight. For construction purposes, we recommend that the optimum lime or cement content of the subgrade soils be determined by additional laboratory testing with representative samples of the subgrade materials being used for this project. Treated subgrade soils should be compacted to a minimum of 95 or 98 percent of the maximum dry density at a moisture content within the range of optimum moisture content to 3 percentage points above the optimum moisture content as determined by Tex-113-E or ASTM D698, respectively.

FLEXIBLE BASE COURSE

The flexible base course should be crushed limestone conforming to TxDOT 2014 Standard Specifications, Item 247, Type A, Grade 1-2. Base course should be placed in loose lifts not exceeding 8 in. in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT Tex-113-E Compaction Test, or 98 percent of maximum dry density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content until final compaction.

ASPHALTIC CONCRETE SURFACE COURSE

The asphaltic concrete surface course should conform to TxDOT Standard Specifications, Item 340, Type C or D. The asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.

PORTLAND CEMENT CONCRETE

The Portland cement concrete should have a minimum 28-day compressive strength of 4,000 psi. A liquid membrane-forming curing compound should be applied as soon as practical after finishing the concrete surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

MISCELLANEOUS PAVEMENT RELATED CONSIDERATIONS

Utilities

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches. It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- All backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and all backfilling procedures should be tested and documented.
- Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

Longitudinal Cracking

It should be understood that asphalt pavement sections in expansive soil environments, such as those encountered at this site, can develop longitudinal cracking along unprotected pavement edges. In the semi-arid climate of south central Texas this condition typically occurs along the unprotected edges of pavements where moisture fluctuation is allowed to occur over the lifetime of the pavements.

Pavements that do not have a protective barrier to reduce moisture fluctuation of the highly expansive clay subgrade between the exposed pavement edge and that beneath the pavement section tend to develop longitudinal cracks 1 to 4 ft from the edge of the pavement. Once these cracks develop, further degradation and weakening of the underlying granular base may occur due to water seepage through the cracks. The occurrence of these cracks can be more prevalent in the absence of lateral restraint and embankments. This problem can best be addressed by providing either a horizontal or vertical moisture barrier at the unprotected pavement edge.

At a minimum, we recommend that the curbs are constructed such that the depth of the curb extends through the entire depth of the granular base material and into the subgrade to act as a protective barrier against the infiltration of water into the granular base.

In most cases, a longitudinal crack does not immediately compromise the structural integrity of the pavement system. However, if left unattended, infiltration of surface water runoff into the crack will result in isolated saturation of the underlying base. This will result in pumping of the flexible base, which could lead to rutting, cracking, and potholes. For this reason, we recommend the owner of the facility immediately seal the cracks and develop a periodic sealing program.

Pavement Maintenance

Regular pavement maintenance is critical in maintaining pavement performance over a period of several years. All cracks that develop in asphalt pavements should be regularly sealed. Areas of moderate to severe fatigue cracking (also known as alligator cracking) should be sawcut and removed. The underlying base should be checked for contamination or loss of support and any insufficiencies fixed or removed and the entire area patched. All cracks that develop in concrete pavements should be routed and sealed regularly. Joints in concrete pavements should be maintained to reduce the influx of incompressible materials that restrain joint movement and cause spalling and/or cracking. Other maintenance techniques should be followed as required.

Construction Traffic

Construction traffic on prepared subgrade or granular base should be restricted as much as possible until the protective surface pavement is applied. Significant damage to the underlying layers resulting in weakening may occur if heavily loaded vehicles are allowed to use these areas

CONSTRUCTION RELATED SERVICES

CONSTRUCTION MATERIALS TESTING AND OBSERVATION SERVICES

As presented in the attachment to this report, *Important Information About Your Geotechnical Engineering Report*, subsurface conditions can vary across a project site. The conditions described in this report are based on interpolations derived from a limited number of data points. Variations will be encountered during construction, and only the geotechnical design engineer will be able to determine if these conditions are different than those assumed for design.

Construction problems resulting from variations or anomalies in subsurface conditions are among the most prevalent on construction projects and often lead to delays, changes, cost overruns, and disputes. These variations and anomalies can best be addressed if the geotechnical engineer of record, RKI is retained to perform construction observation and testing services during the construction of the project. This is because:

- RKI has an intimate understanding of the geotechnical engineering report's findings and recommendations. RKI understands how the report should be interpreted and can provide such interpretations on site, on the client's behalf.
- RKI knows what subsurface conditions are anticipated at the site.
- RKI is familiar with the goals of the owner and project design professionals, having worked with them in the development of the geotechnical workscope. This enables RKI to suggest remedial measures (when needed) which help meet the owner's and the design teams' requirements.
- RKI has a vested interest in client satisfaction, and thus assigns qualified personnel whose principal concern is client satisfaction. This concern is exhibited by the manner in which contractors' work is tested, evaluated and reported, and in selection of alternative approaches when such may become necessary.
- RKI cannot be held accountable for problems which result due to misinterpretation of our findings or recommendations when we are not on hand to provide the interpretation which is required.

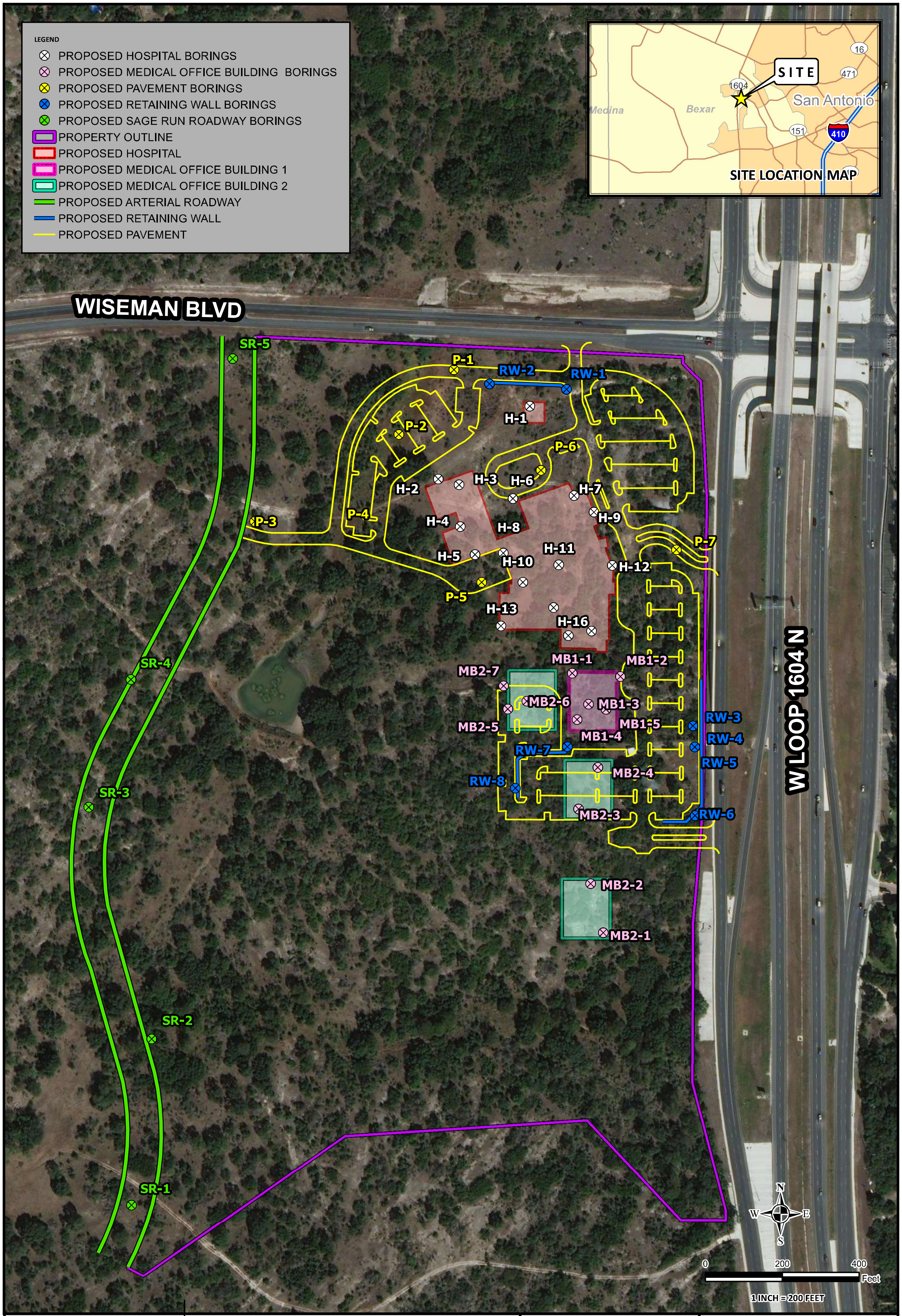
BUDGETING FOR CONSTRUCTION TESTING

Appropriate budgets need to be developed for the required construction testing and observation activities. At the appropriate time before construction, we advise that RKI and the project designers meet and jointly develop the testing budgets, as well as review the testing specifications as it pertains to this project.

Once the construction testing budget and scope of work are finalized, we encourage a preconstruction meeting with the selected contractor to review the scope of work to make sure it is consistent with the construction means and methods proposed by the contractor. RKI looks forward to the opportunity to provide continued support on this project, and would welcome the opportunity to meet with the Project Team to develop both a scope and budget for these services.

* * * * * * * * * * * * * * * * * *

ATTACHMENTS



RABA KISTNER

12821 West Golden Lane
San Antonio, Texas 78249
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F 210 :: 699 :: 6426
TBPE Firm F-3257 / TBPG Firm #50220

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

BORING LOCATION MAP

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
WESTOVER HILLS HOSPITAL
LOOP 1604 AND WISEMAN ROAD
BEXAR COUNTY, TEXAS

REVISIONS:

No.	DATE	DESCRIPTION

PROJECT No.:	ASA21-058-02
ISSUE DATE:	05/17/2022
DRAWN BY:	BM
CHECKED BY:	DNG
REVIEWED BY:	EJN

FIGURE

1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

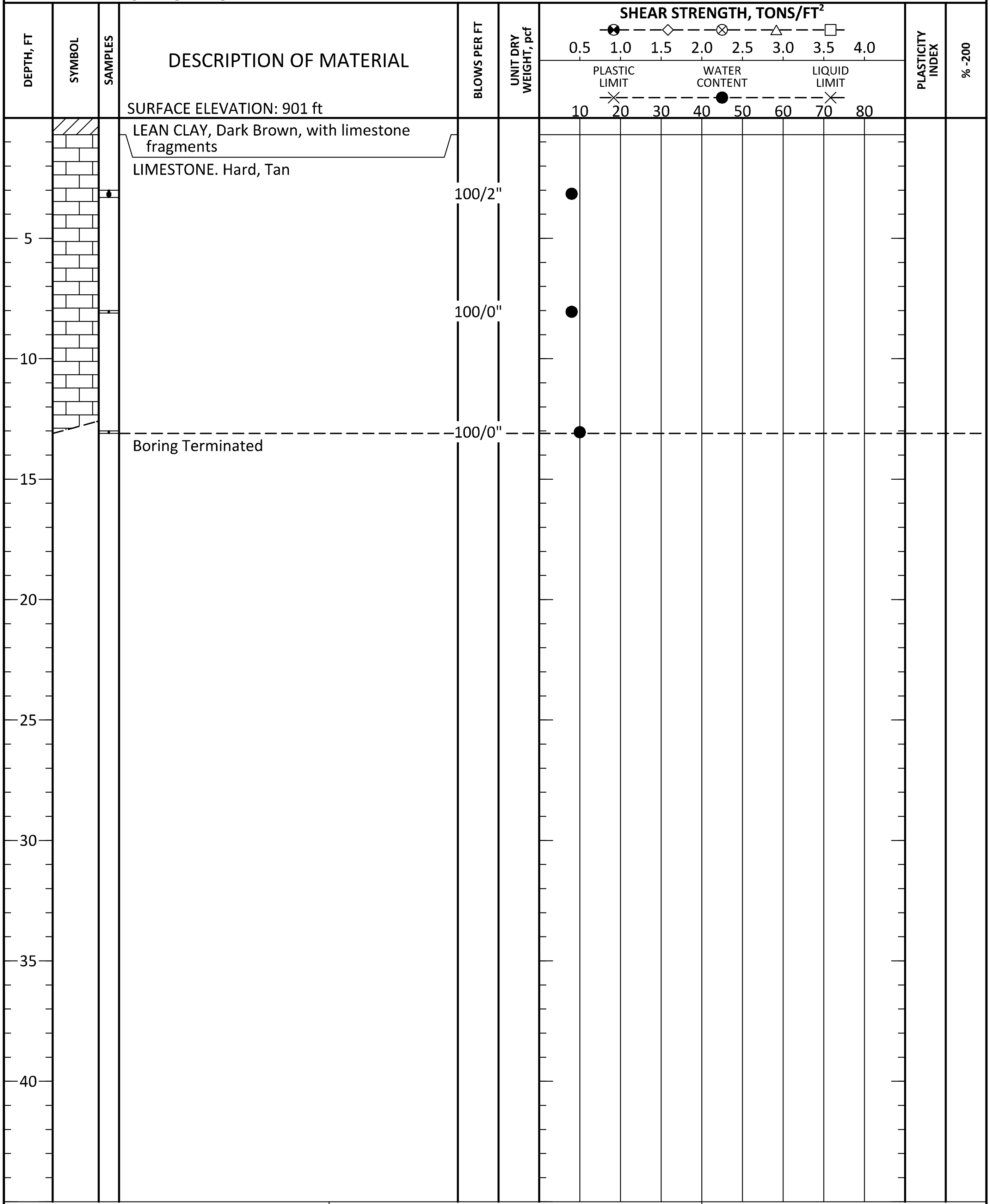
LOG OF BORING NO. H-1

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46494; W 98.71364



SURFACE ELEVATION: 901 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT
LEAN CLAY, Dark Brown, with limestone fragments	
LIMESTONE. Hard, Tan	100/2"
	100/0"
	100/0"
Boring Terminated	

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 13.1 ft
DATE DRILLED: 5/17/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/17/2022

PROJ. No.: ASA21-058-02
FIGURE: 2

LOG OF BORING NO. H-2

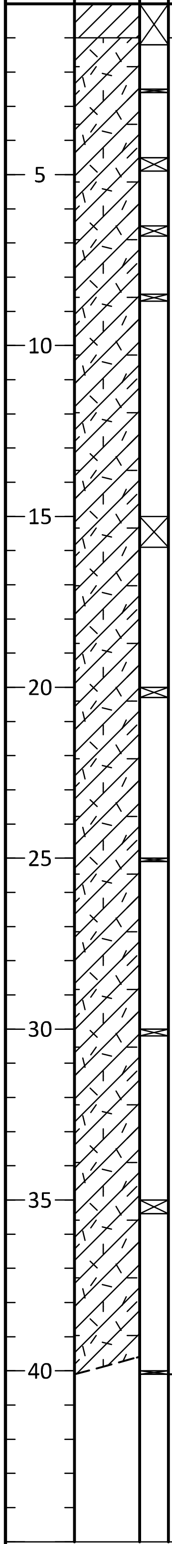
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

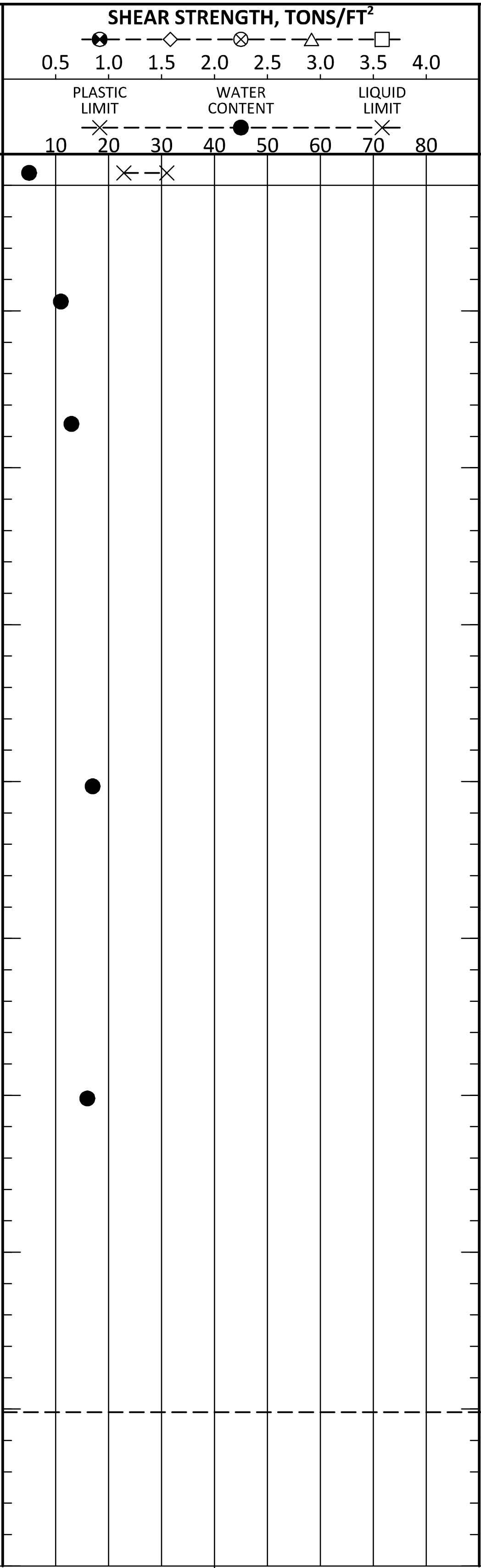
DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46442; W 98.71439

SURFACE ELEVATION: 892 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
LEAN CLAY, Hard, Brown to Tan, with limestone fragments	50/8"		8	
MARL. Hard, Tan	ref/1"			
	ref/5"			
	ref/4'			
	ref/2"			
	50/5"			
	ref/3"			
	ref/1"			
	ref/2'			
	ref/5"			
	ref/1"			
Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	40.1 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/12/2022	**DATE MEASURED:**	5/12/2022	**FIGURE:**	3

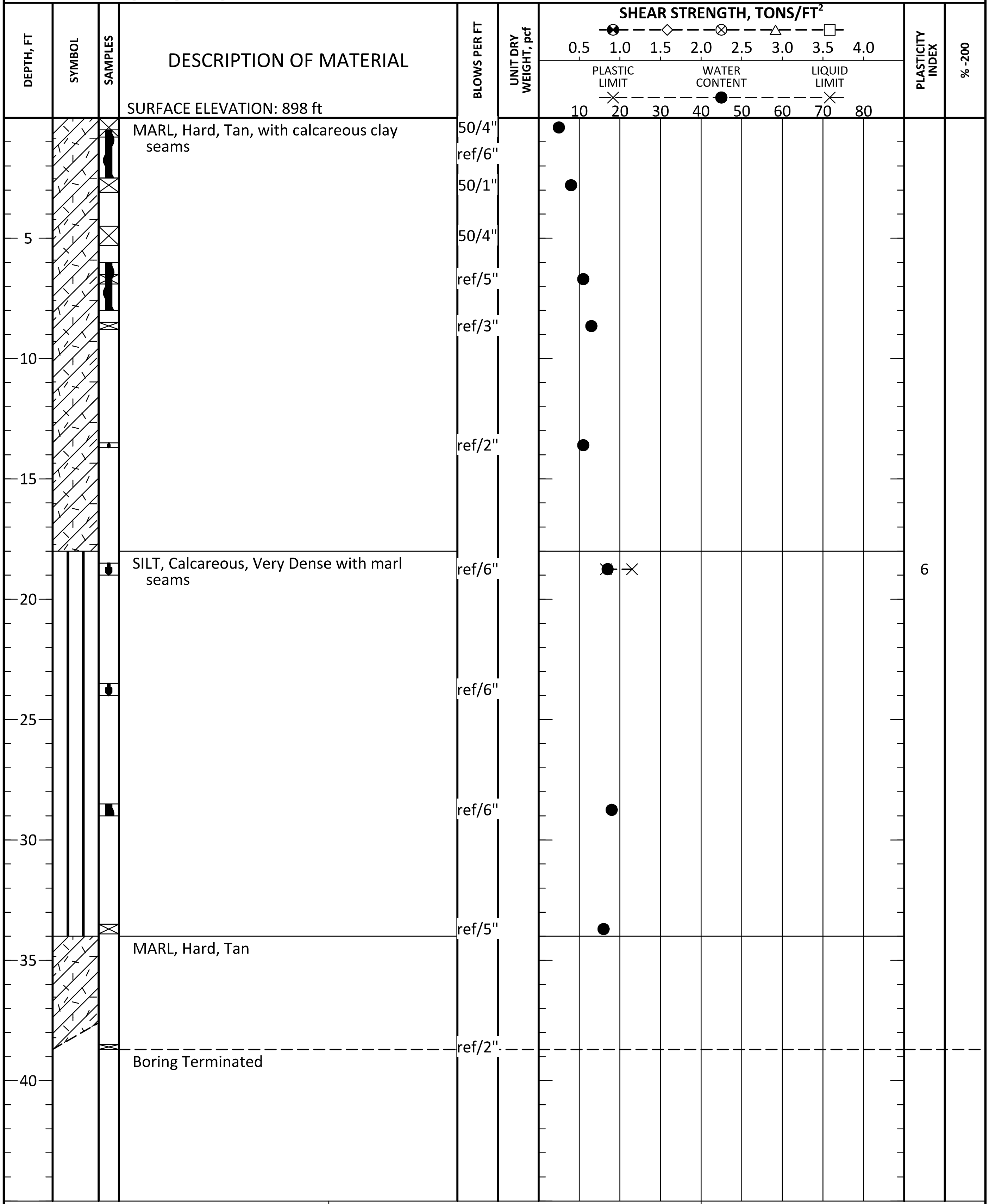
LOG OF BORING NO. H-3

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46438; W 98.71422



SURFACE ELEVATION: 898 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
MARL, Hard, Tan, with calcareous clay seams	50/4"	
	ref/6"	
	50/1"	
	50/4"	
	ref/5"	
	ref/3"	
	ref/2"	
SILT, Calcareous, Very Dense with marl seams	ref/6"	6
	ref/6"	
	ref/6"	
	ref/5"	
MARL, Hard, Tan	ref/2"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 38.7 ft
DATE DRILLED: 5/4/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022

PROJ. No.: ASA21-058-02
FIGURE: 4

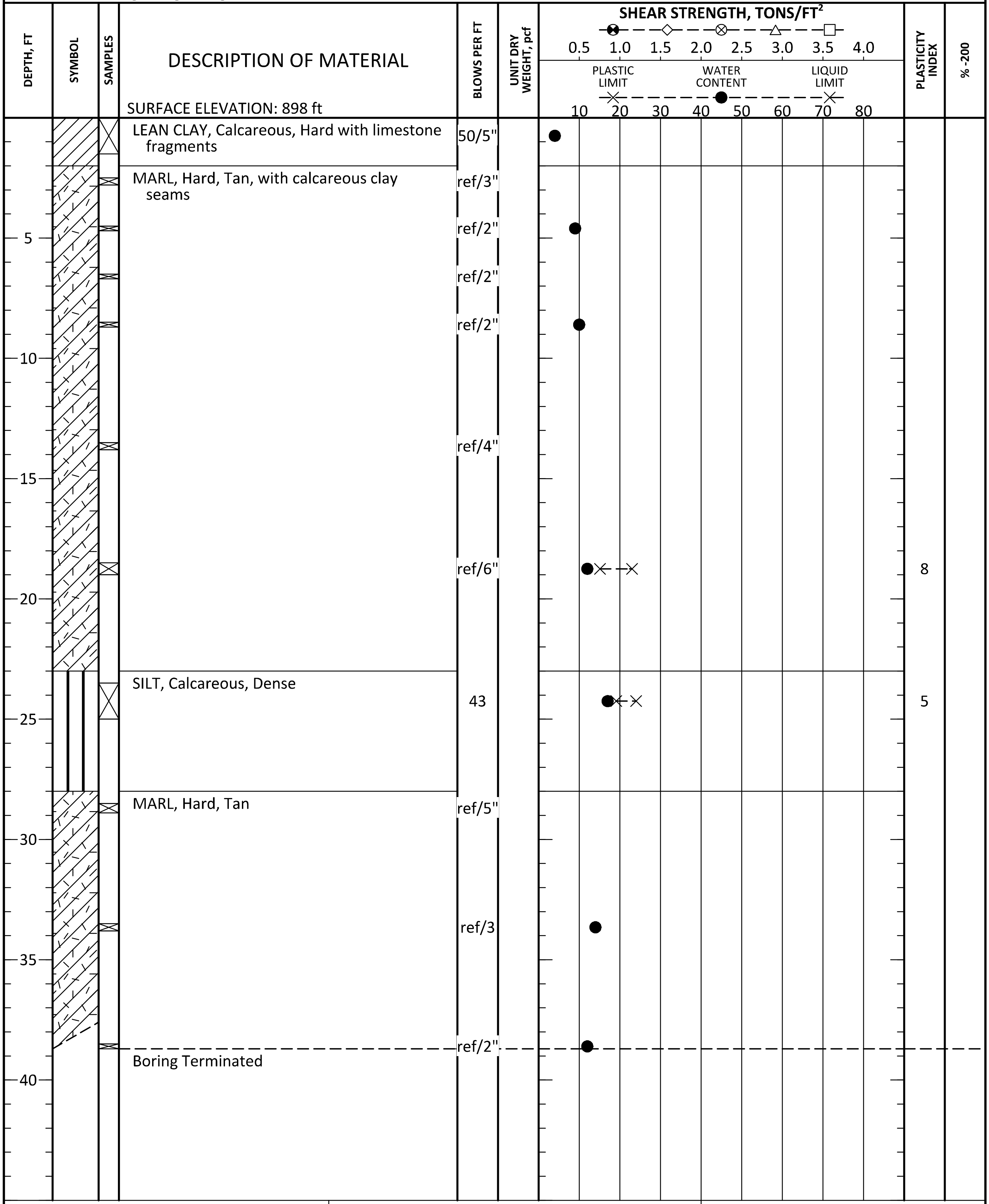
LOG OF BORING NO. H-4

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46408; W 98.71421



LEAN CLAY, Calcareous, Hard with limestone fragments	50/5"	
MARL, Hard, Tan, with calcareous clay seams	ref/3"	
	ref/2"	
	ref/2"	
	ref/2"	
	ref/4"	
	ref/6"	8
SILT, Calcareous, Dense	43	5
MARL, Hard, Tan	ref/5"	
	ref/3	
	ref/2"	
Boring Terminated		

DEPTH DRILLED: 38.7 ft
DATE DRILLED: 4/25/2022

DEPTH TO WATER: Dry
DATE MEASURED: 4/25/2022

PROJ. No.: ASA21-058-02
FIGURE: 5

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

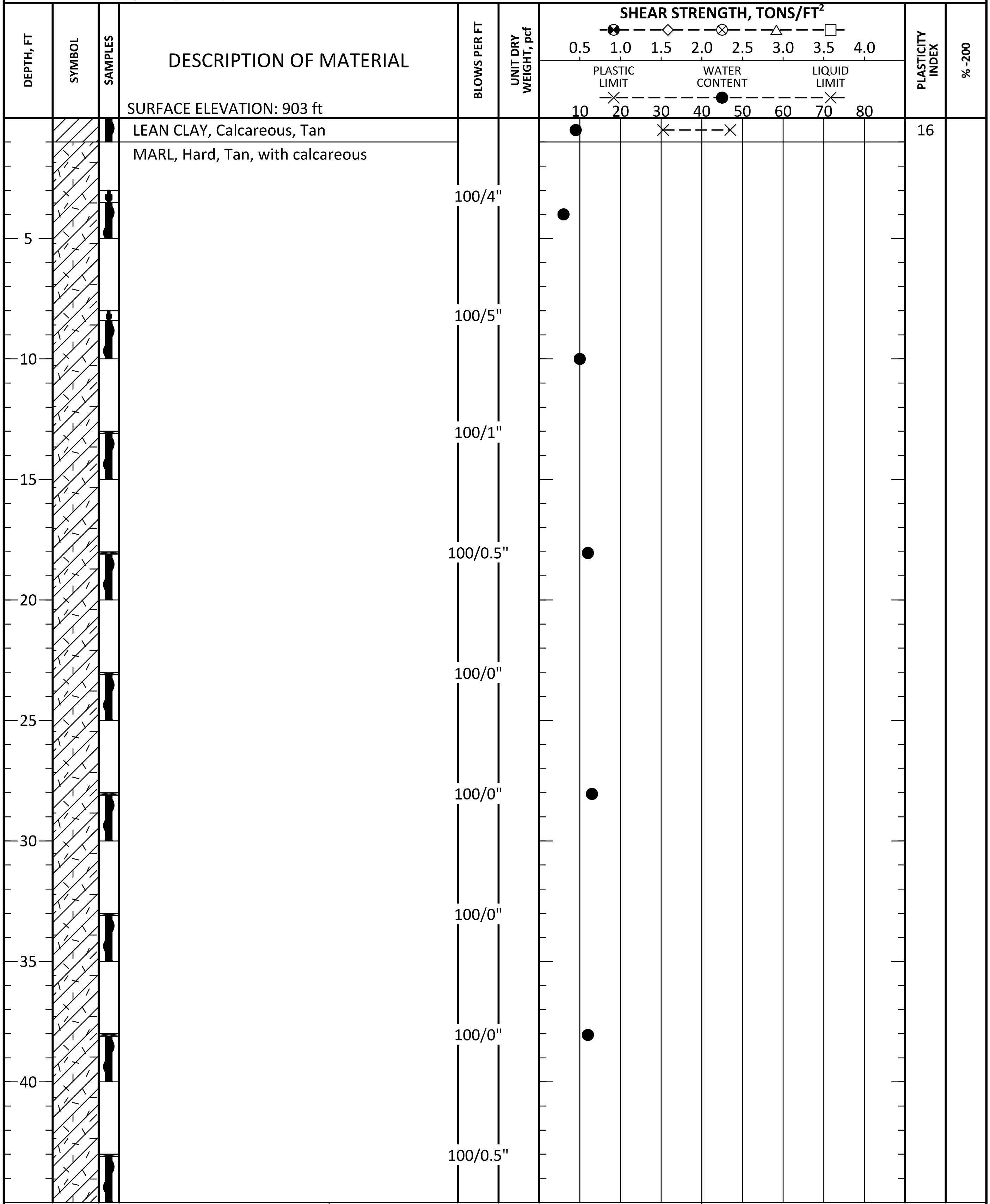
LOG OF BORING NO. H-5

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46388; W 98.71409



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	55.0 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/13/2022	**DATE MEASURED:**	5/13/2022	**FIGURE:**	6a

LOG OF BORING NO. H-5

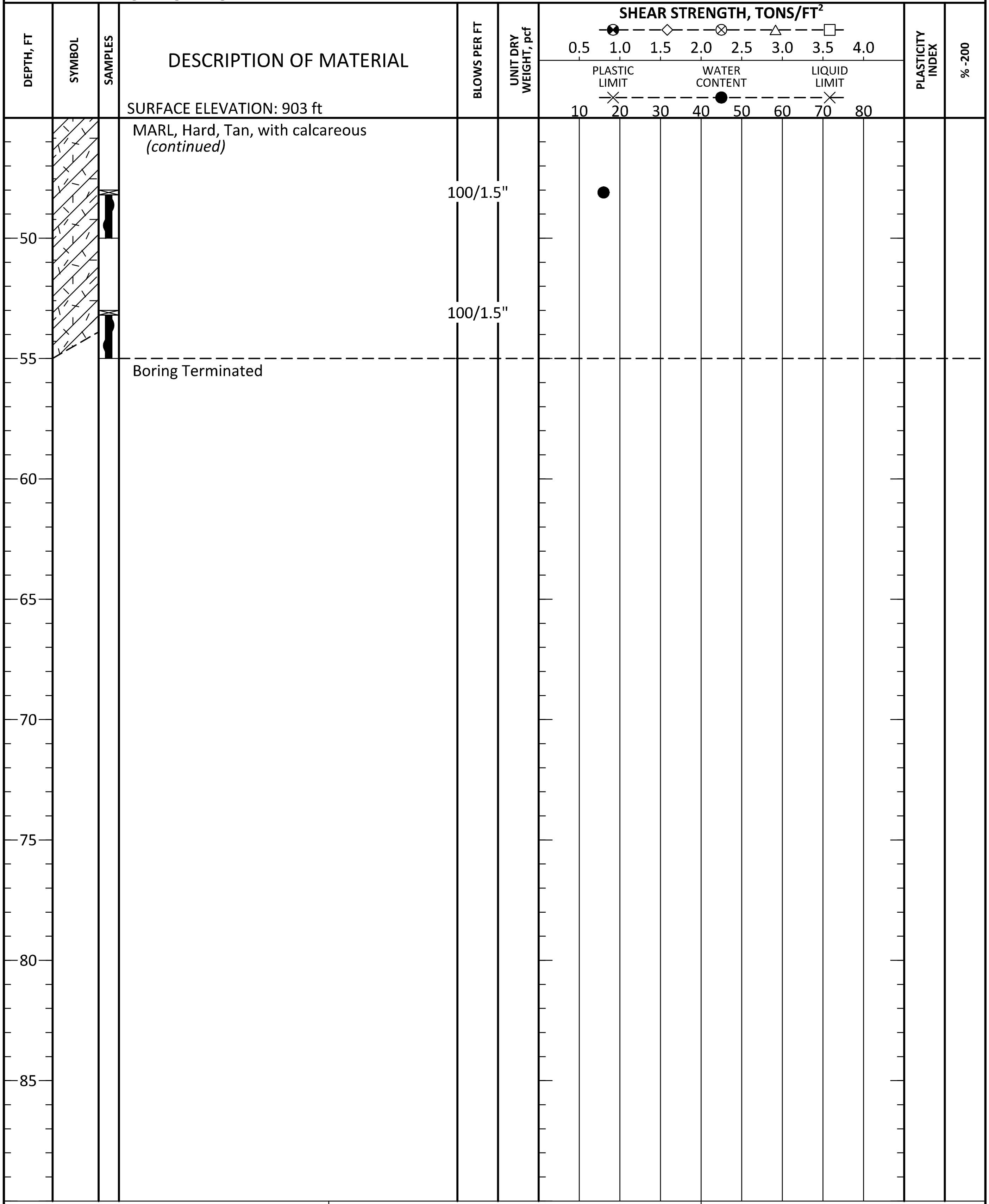
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46388; W 98.71409

SURFACE ELEVATION: 903 ft



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	MARL, Hard, Tan, with calcareous *(continued)*	
		100/1.5"
50		
		100/1.5"
55	Boring Terminated	

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.0 ft
DATE DRILLED: 5/13/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/13/2022
PROJ. No.: ASA21-058-02
FIGURE: 6b

LOG OF BORING NO. H-6

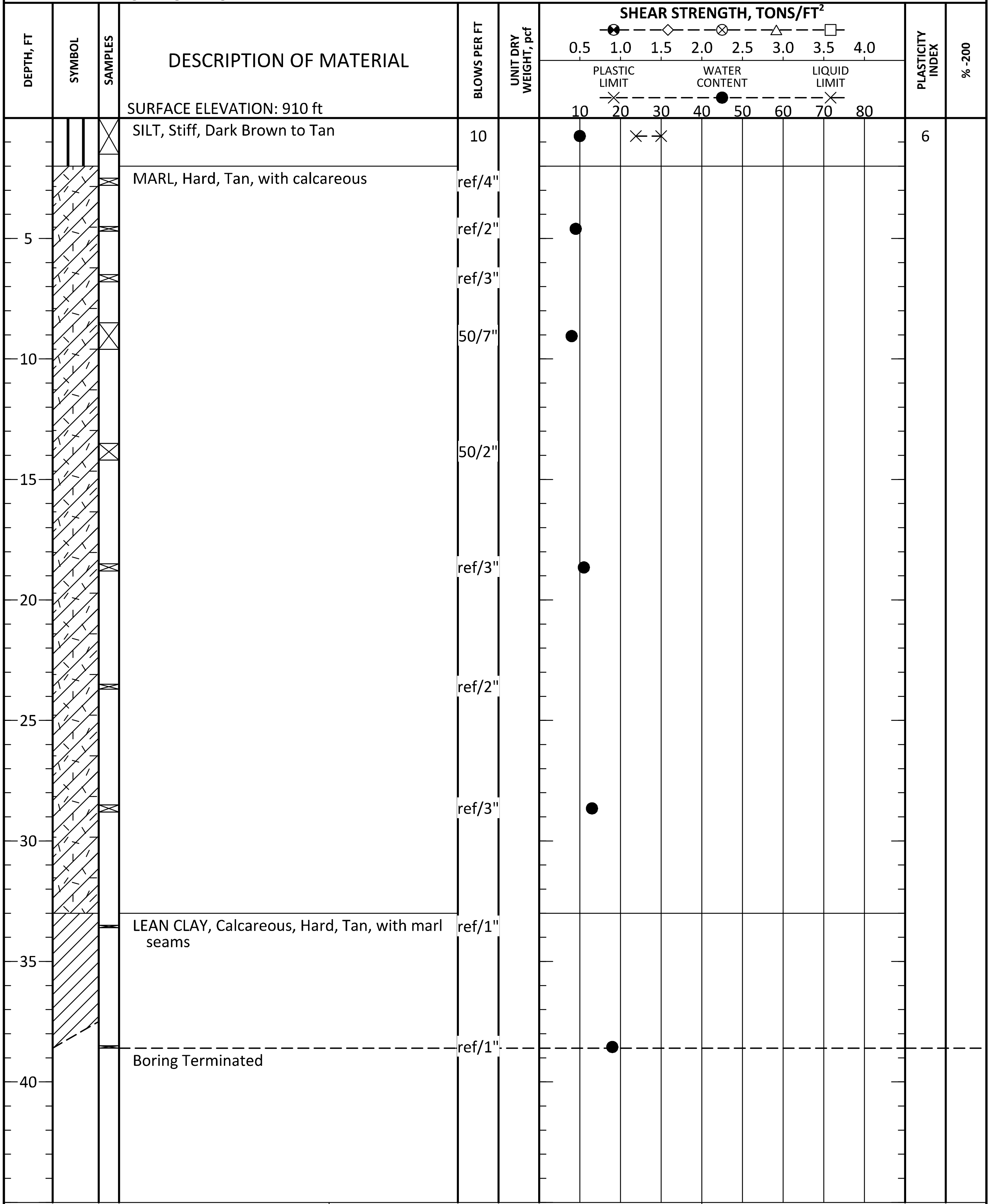
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46428; W 98.71378

SURFACE ELEVATION: 910 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
SILT, Stiff, Dark Brown to Tan	10		6	
MARL, Hard, Tan, with calcareous	ref/4"			
	ref/2"			
	ref/3"			
	50/7"			
	50/2"			
	ref/3"			
	ref/2"			
	ref/3"			
LEAN CLAY, Calcareous, Hard, Tan, with marl seams	ref/1"			
	ref/1"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 38.6 ft
DATE DRILLED: 4/20/2022

DEPTH TO WATER: Dry
DATE MEASURED: 4/20/2022

PROJ. No.: ASA21-058-02
FIGURE: 7

LOG OF BORING NO. H-7

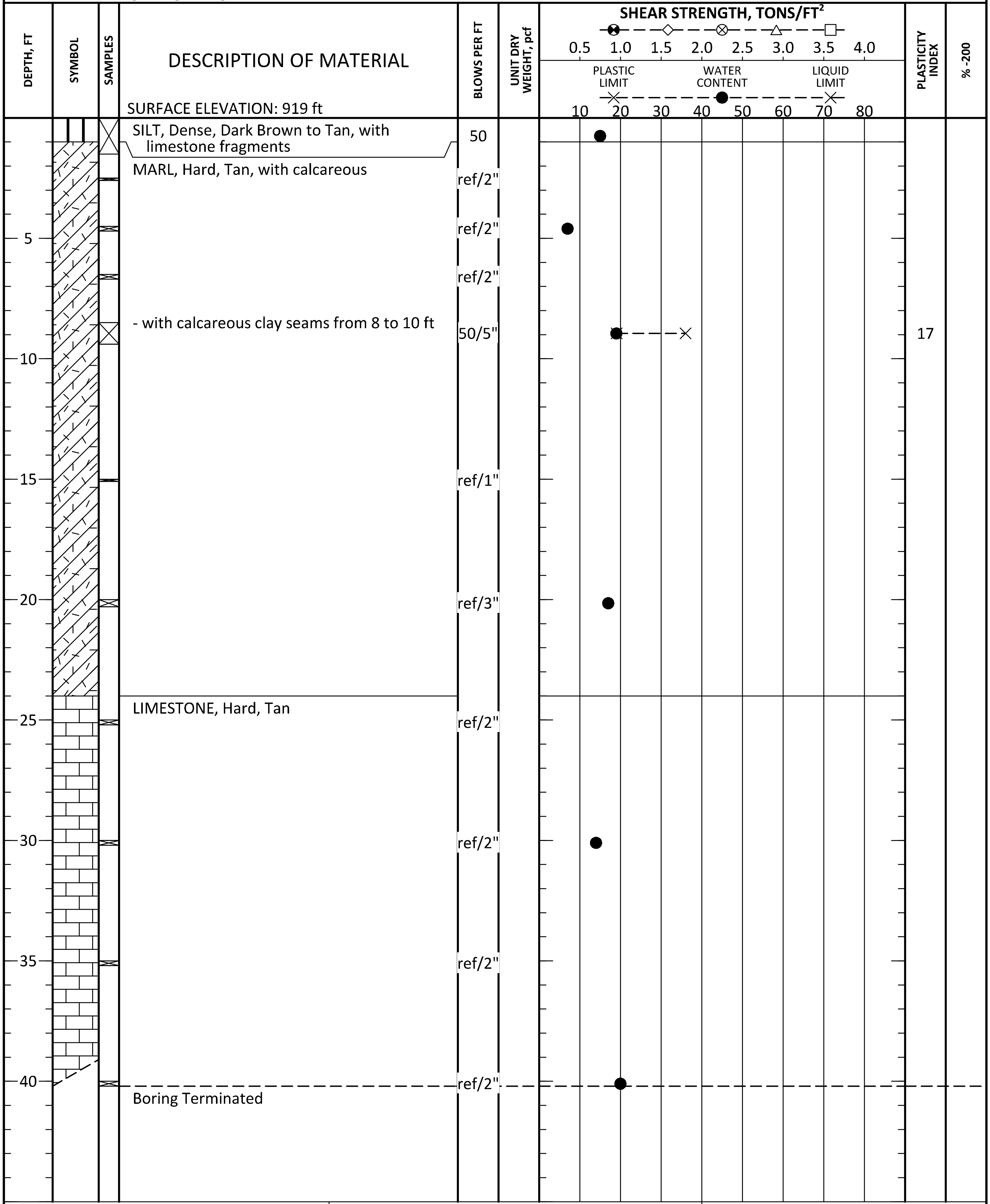
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46430; W 98.71328

SURFACE ELEVATION: 919 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
SILT, Dense, Dark Brown to Tan, with limestone fragments	50	
MARL, Hard, Tan, with calcareous	ref/2"	
	ref/2"	
	ref/2"	
- with calcareous clay seams from 8 to 10 ft	50/5"	17
	ref/1"	
	ref/3"	
LIMESTONE, Hard, Tan	ref/2"	
	ref/2"	
	ref/2"	
Boring Terminated	ref/2"	

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 40.2 ft
DATE DRILLED: 5/12/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/12/2022
PROJ. No.: ASA21-058-02
FIGURE: 8

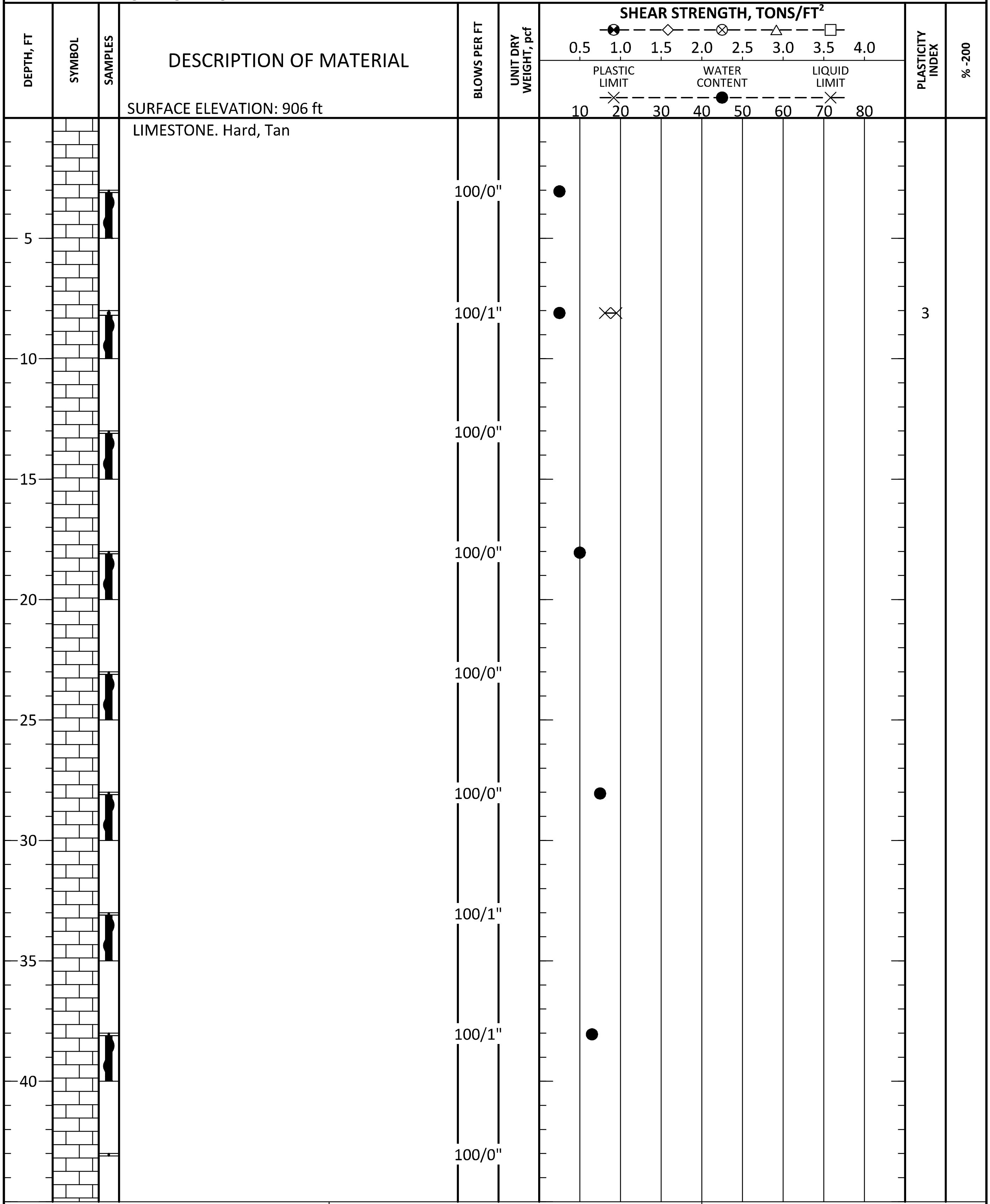
LOG OF BORING NO. H-8

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46389; W 98.71386



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	55.0 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/17/2022	**DATE MEASURED:**	5/17/2022	**FIGURE:**	9a

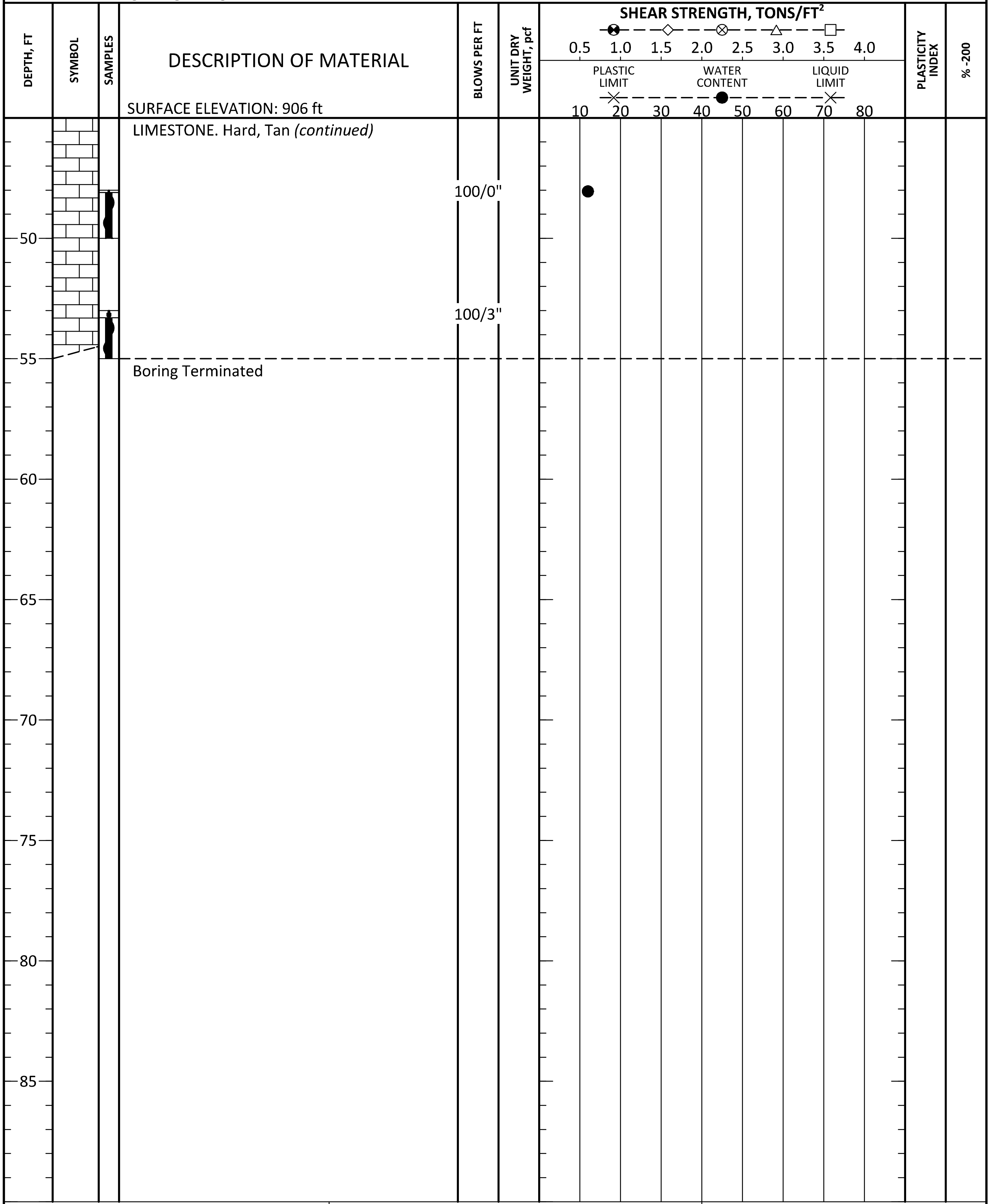
LOG OF BORING NO. H-8

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46389; W 98.71386



SURFACE ELEVATION: 906 ft

LIMESTONE. Hard, Tan *(continued)*

100/0"

100/3"

Boring Terminated

DEPTH DRILLED: 55.0 ft	**DEPTH TO WATER:** Dry	**PROJ. No.:** ASA21-058-02
DATE DRILLED: 5/17/2022	**DATE MEASURED:** 5/17/2022	**FIGURE:** 9b

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. H-9

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

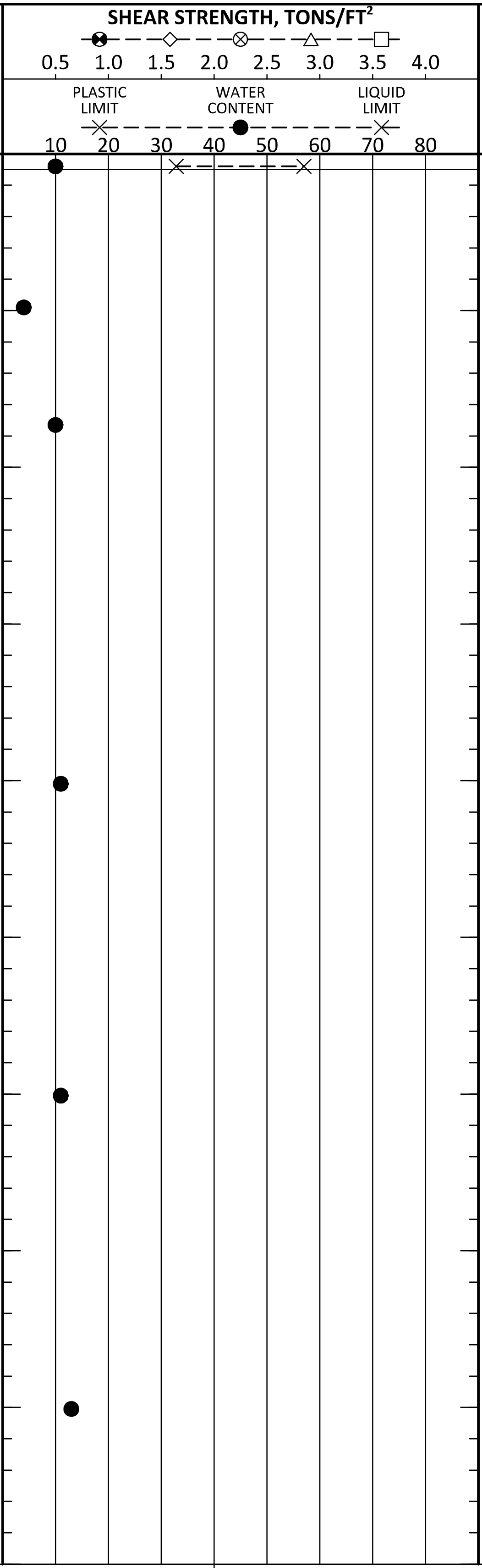
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46418; W 98.71312

SURFACE ELEVATION: 922 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	FAT CLAY, Hard, Dark Brown, with limestone fragments	ref/4"		24	
	MARL, Hard, Tan				
		ref/2"			
5		ref/1"			
		ref/2"			
		ref/2"			
10					
15		ref/2"			
20		ref/2"			
25		ref/1"			
30		ref/2"			
35		ref/1"			
40		ref/2"			



DEPTH DRILLED: 55.1 ft
DATE DRILLED: 5/11/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/11/2022

PROJ. No.: ASA21-058-02
FIGURE: 10a

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

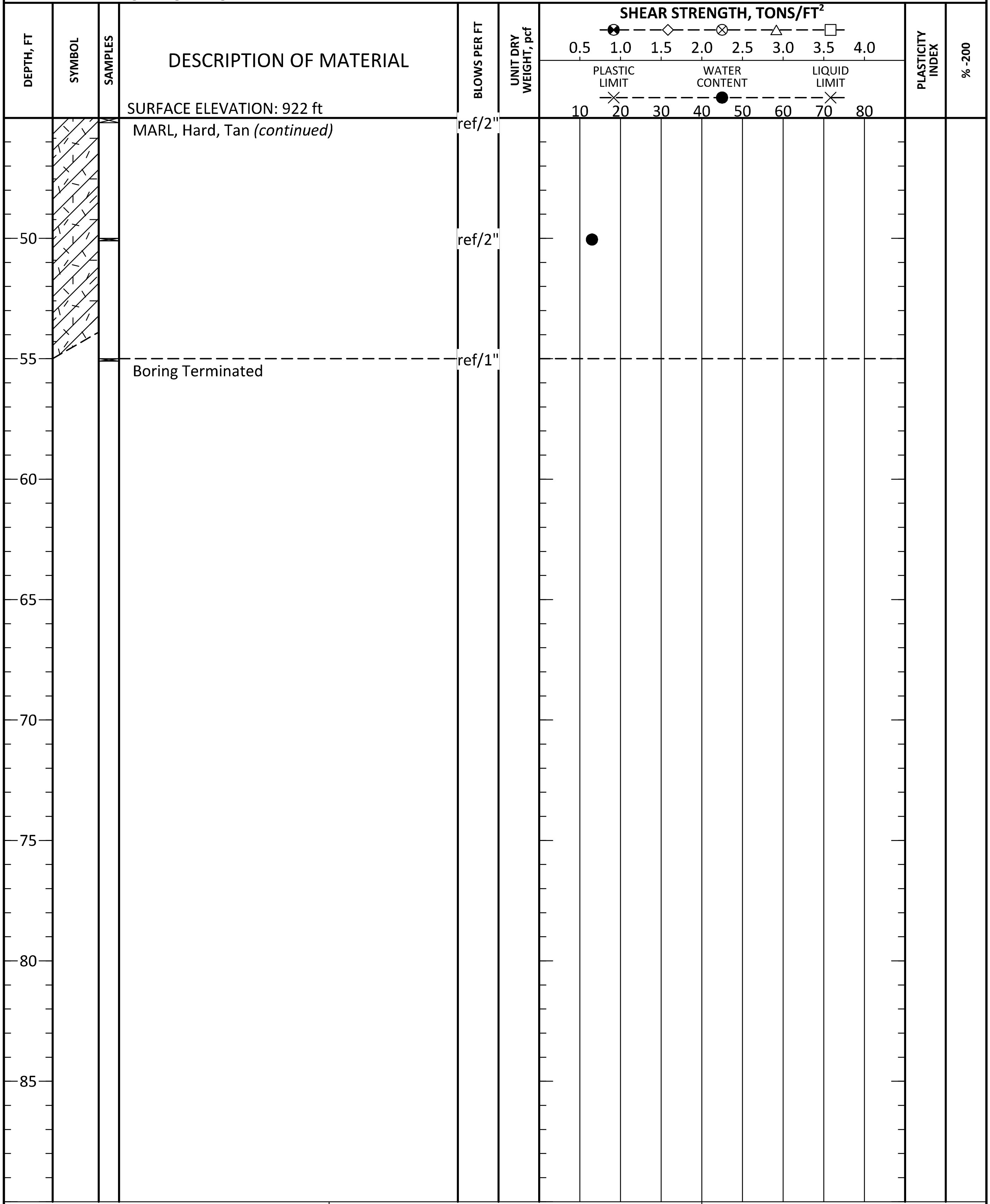
LOG OF BORING NO. H-9

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46418; W 98.71312



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.1 ft
DATE DRILLED: 5/11/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/11/2022

PROJ. No.: ASA21-058-02
FIGURE: 10b

LOG OF BORING NO. H-10

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

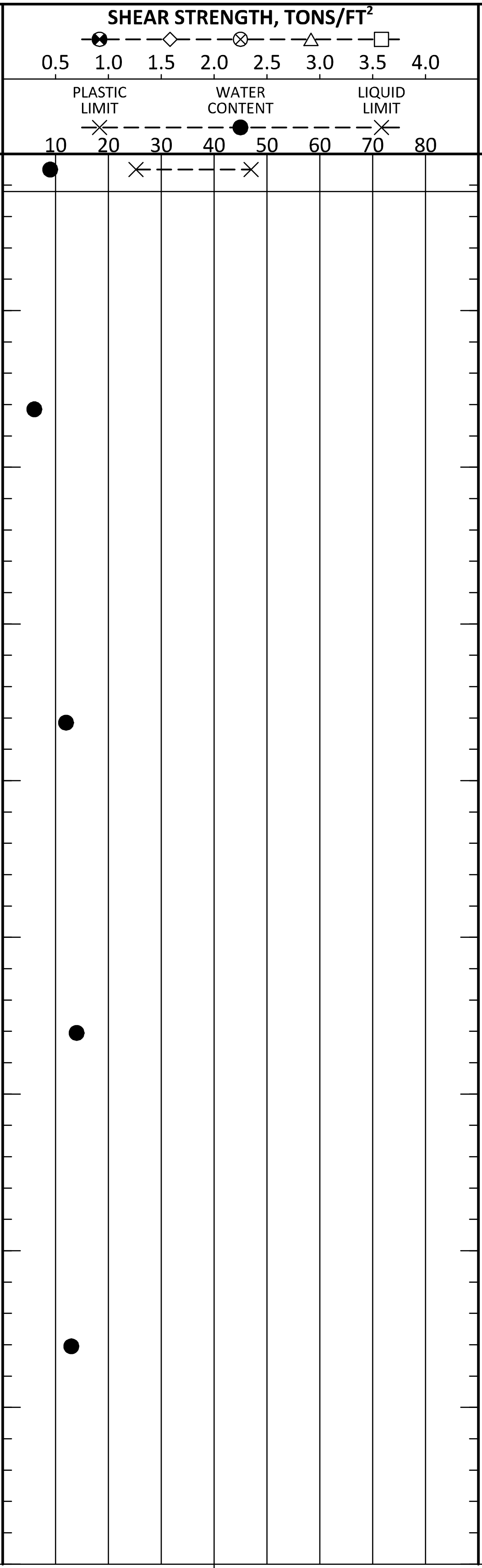
DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46368; W 98.71370

SURFACE ELEVATION: 905 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
LEAN CLAY, Dark Brown			22	
LIMESTONE. Hard, Tan	100/0			
	100/1"			
	100/0"			
	100/0"			
	100/0"			
	100/0.5"			
	100/1.5"			
	100/0.5"			
	100/0"			

DEPTH, FT: 5, 10, 15, 20, 25, 30, 35, 40



DEPTH DRILLED: 55.0 ft	**DEPTH TO WATER:** Dry	**PROJ. No.:** ASA21-058-02	
DATE DRILLED: 5/16/2022	**DATE MEASURED:** 5/16/2022	**FIGURE:** 11a	

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

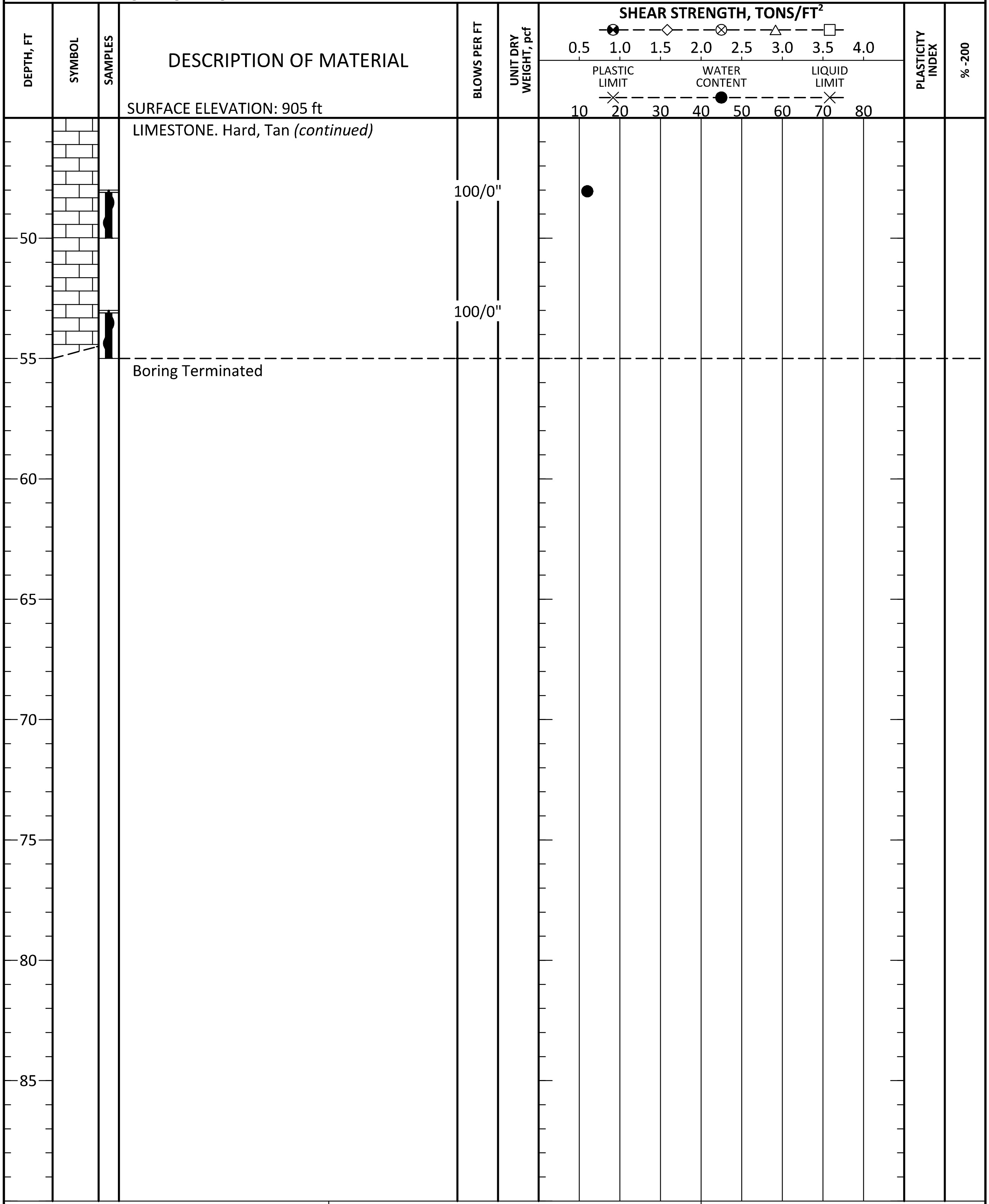
LOG OF BORING NO. H-10

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46368; W 98.71370



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.0 ft
DATE DRILLED: 5/16/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/16/2022

PROJ. No.: ASA21-058-02
FIGURE: 11b

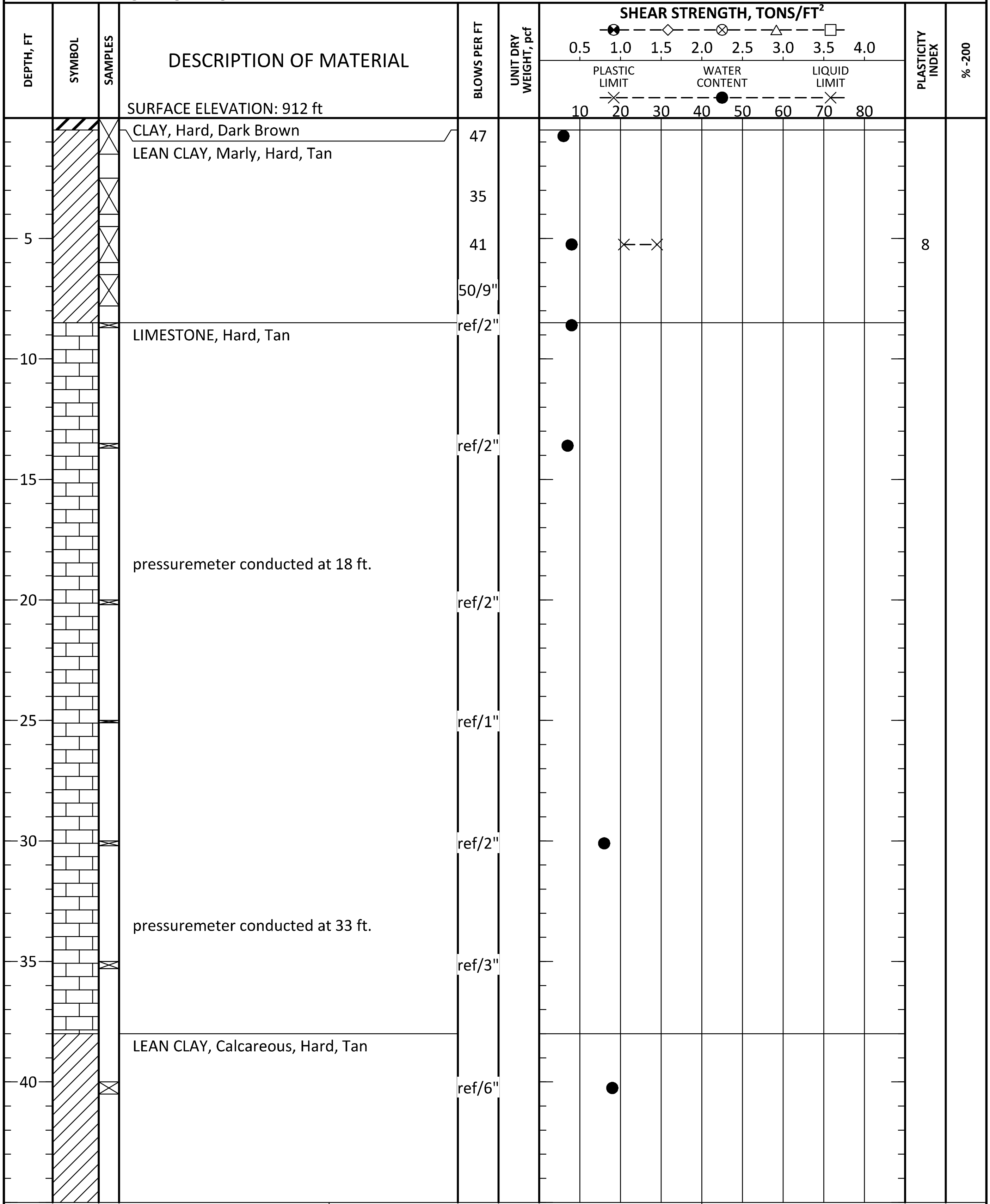
LOG OF BORING NO. H-11

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46381; W 98.71341



SURFACE ELEVATION: 912 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
CLAY, Hard, Dark Brown	47			
LEAN CLAY, Marly, Hard, Tan				
	35			
	41		8	
	50/9"			
	ref/2"			
LIMESTONE, Hard, Tan				
	ref/2"			
pressuremeter conducted at 18 ft.				
	ref/2"			
	ref/1"			
	ref/2"			
pressuremeter conducted at 33 ft.				
	ref/3"			
LEAN CLAY, Calcareous, Hard, Tan				
	ref/6"			

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.2 ft
DATE DRILLED: 5/4/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022
PROJ. No.: ASA21-058-02
FIGURE: 12a

LOG OF BORING NO. H-11

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46381; W 98.71341

SURFACE ELEVATION: 912 ft

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70 80

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH / WATER CONTENT	PLASTICITY INDEX	% -200
	▨	☒	LEAN CLAY, Calcareous, Hard, Tan *(continued)*	50/5"		● 20		
			MARL, Hard, Tan pressuremeter conducted at 48 ft.					
50				ref/1"				
55				ref/2"				
			Boring Terminated					
60								
65								
70								
75								
80								
85								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.2 ft
DATE DRILLED: 5/4/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022
PROJ. No.: ASA21-058-02
FIGURE: 12b

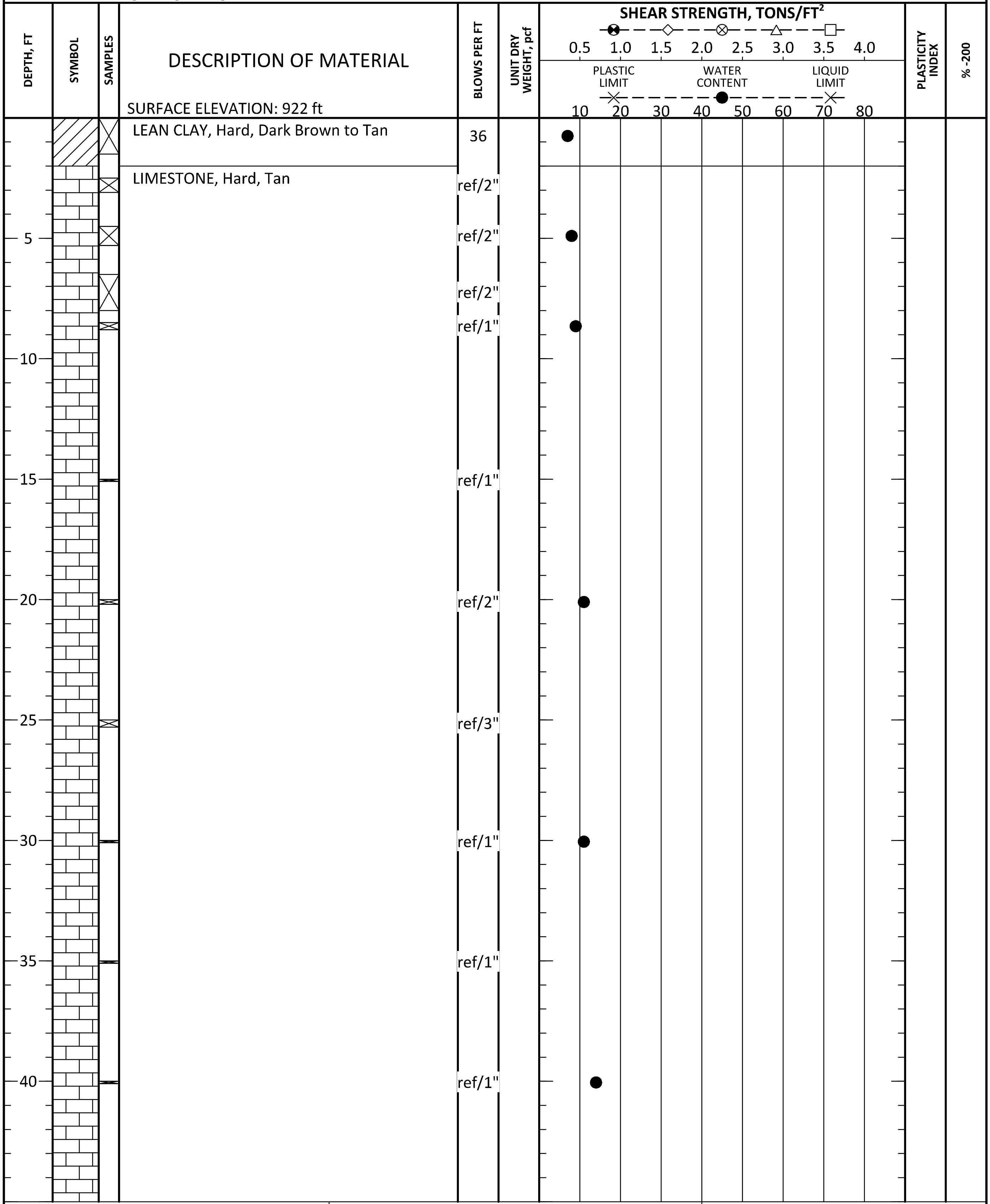
LOG OF BORING NO. H-12

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46380; W 98.71297



LEAN CLAY, Hard, Dark Brown to Tan

LIMESTONE, Hard, Tan

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.1 ft
DATE DRILLED: 5/11/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/11/2022

PROJ. No.: ASA21-058-02
FIGURE: 13a

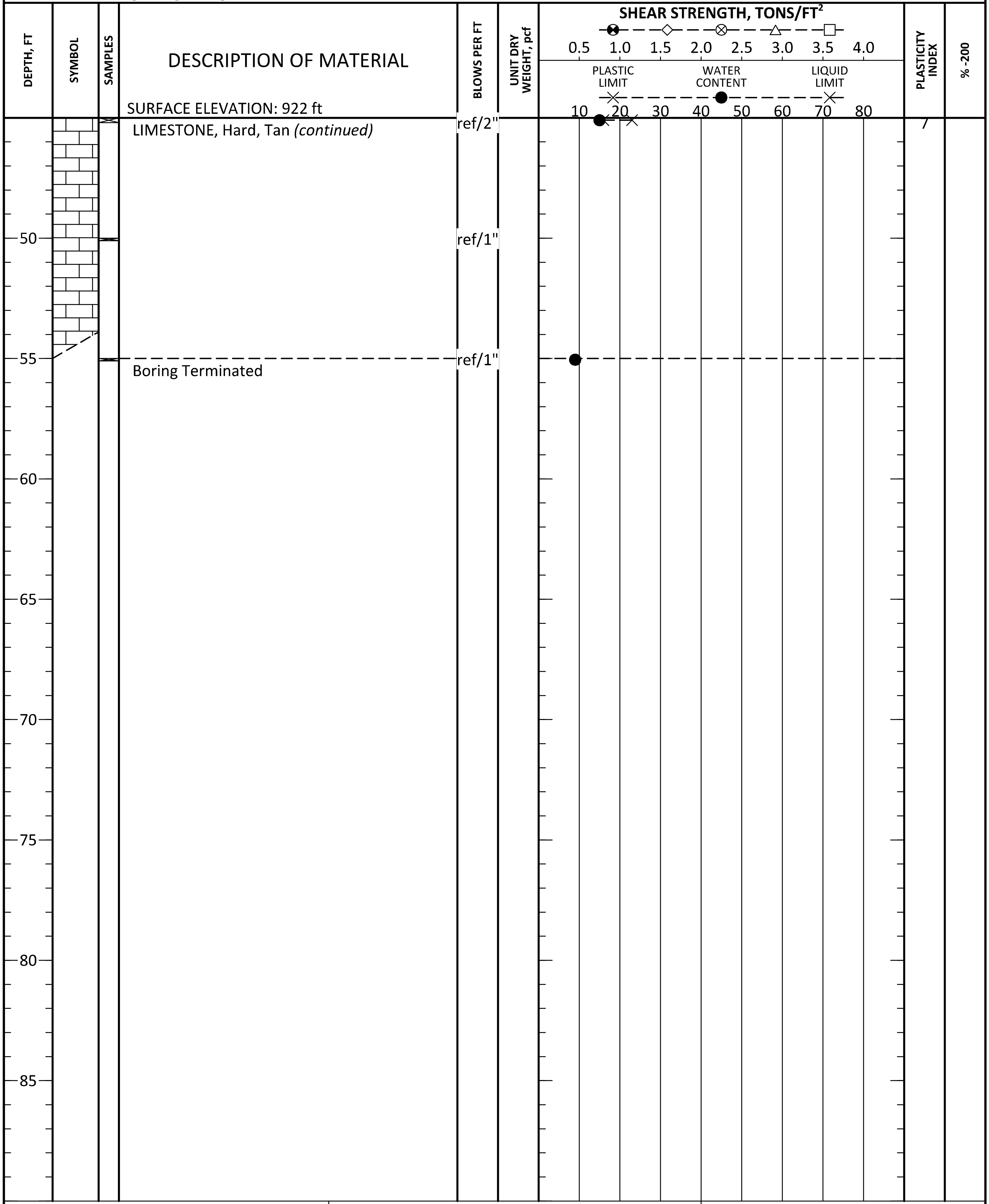
LOG OF BORING NO. H-12

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46380; W 98.71297



LIMESTONE, Hard, Tan *(continued)*

ref/2"		7
ref/1"		
ref/1"		

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.1 ft
DATE DRILLED: 5/11/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/11/2022

PROJ. No.: ASA21-058-02
FIGURE: 13b

LOG OF BORING NO. H-13

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

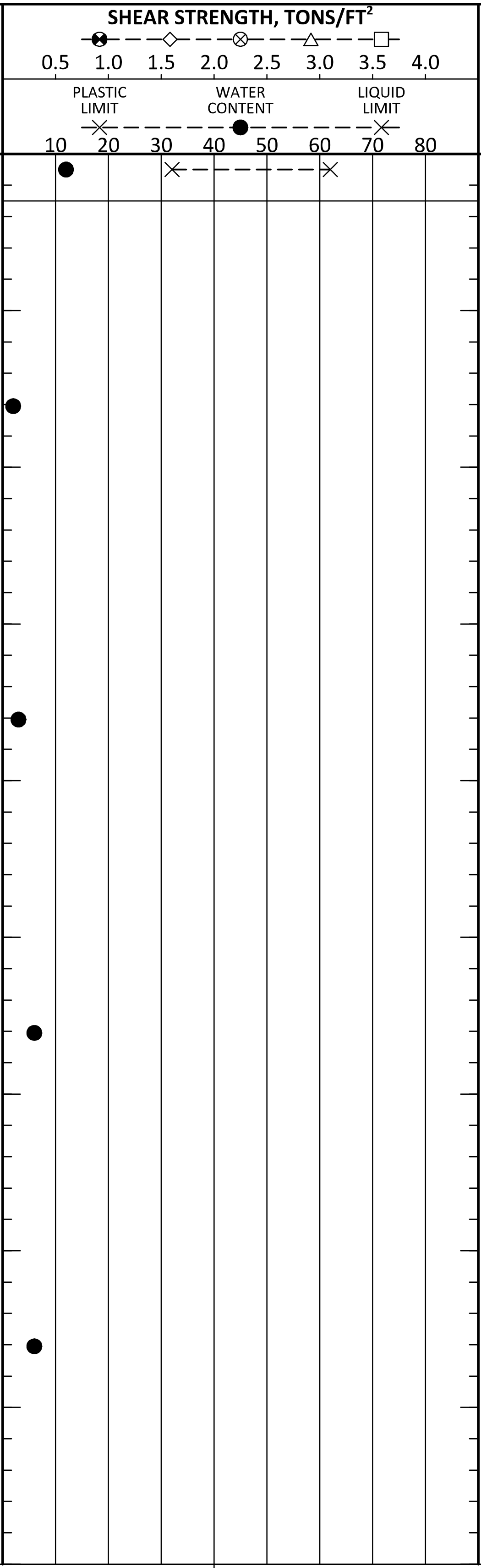
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46350; W 98.71345

SURFACE ELEVATION: 906 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	FAT CLAY, Dark Brown to Reddish Brown			30	
	LIMESTONE, Hard, Tan				
		100/1"			
5					
		100/1"			
10					
		100/1"			
15					
		100/1"			
20					
		100/1"			
25					
		100/1"			
30					
		100/1"			
35					
		100/1"			
40					
		100/1"			



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.0 ft
DATE DRILLED: 5/17/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/17/2022

PROJ. No.: ASA21-058-02
FIGURE: 14a

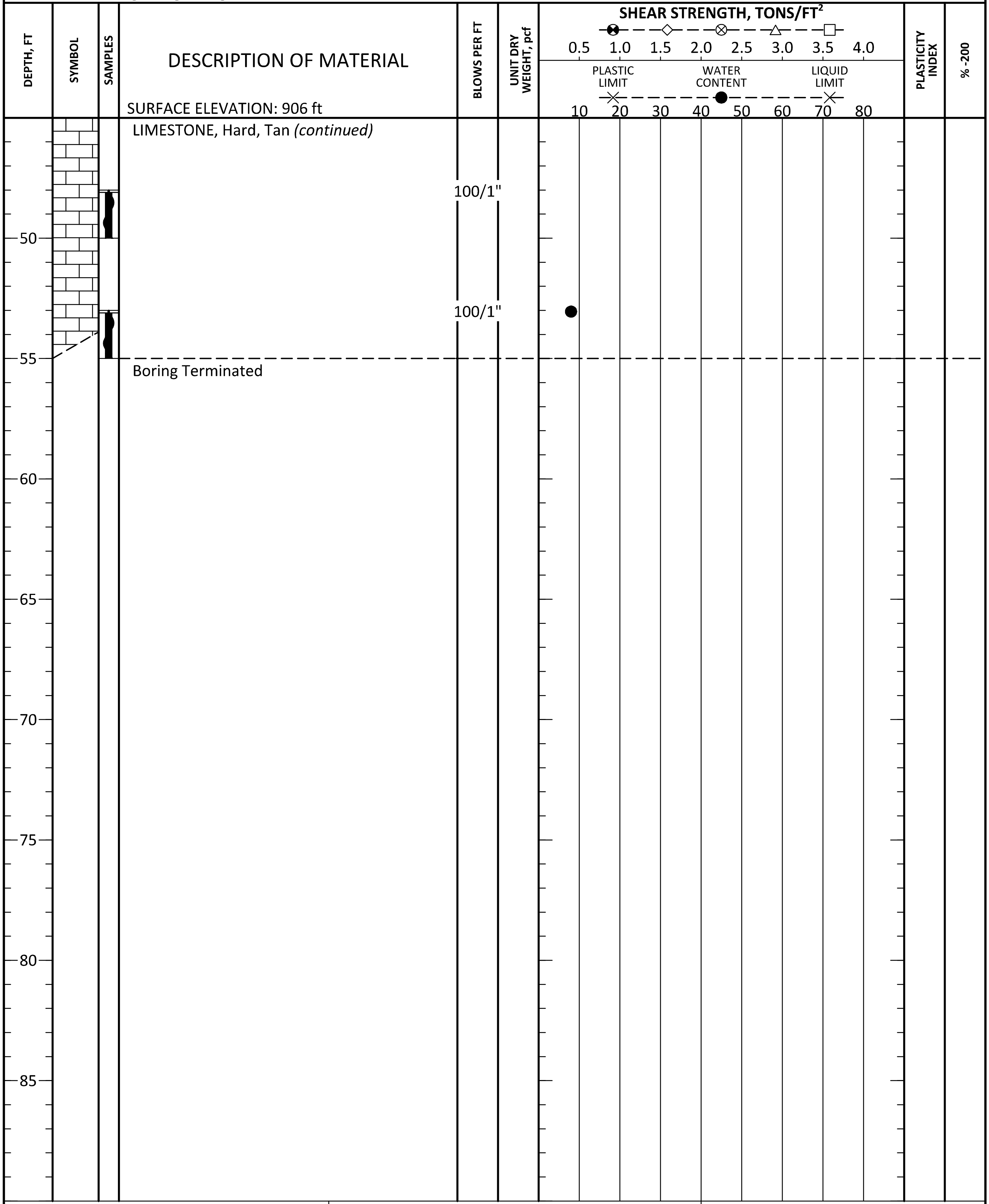
LOG OF BORING NO. H-13

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46350; W 98.71345



LIMESTONE, Hard, Tan *(continued)*

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.0 ft
DATE DRILLED: 5/17/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/17/2022

PROJ. No.: ASA21-058-02
FIGURE: 14b

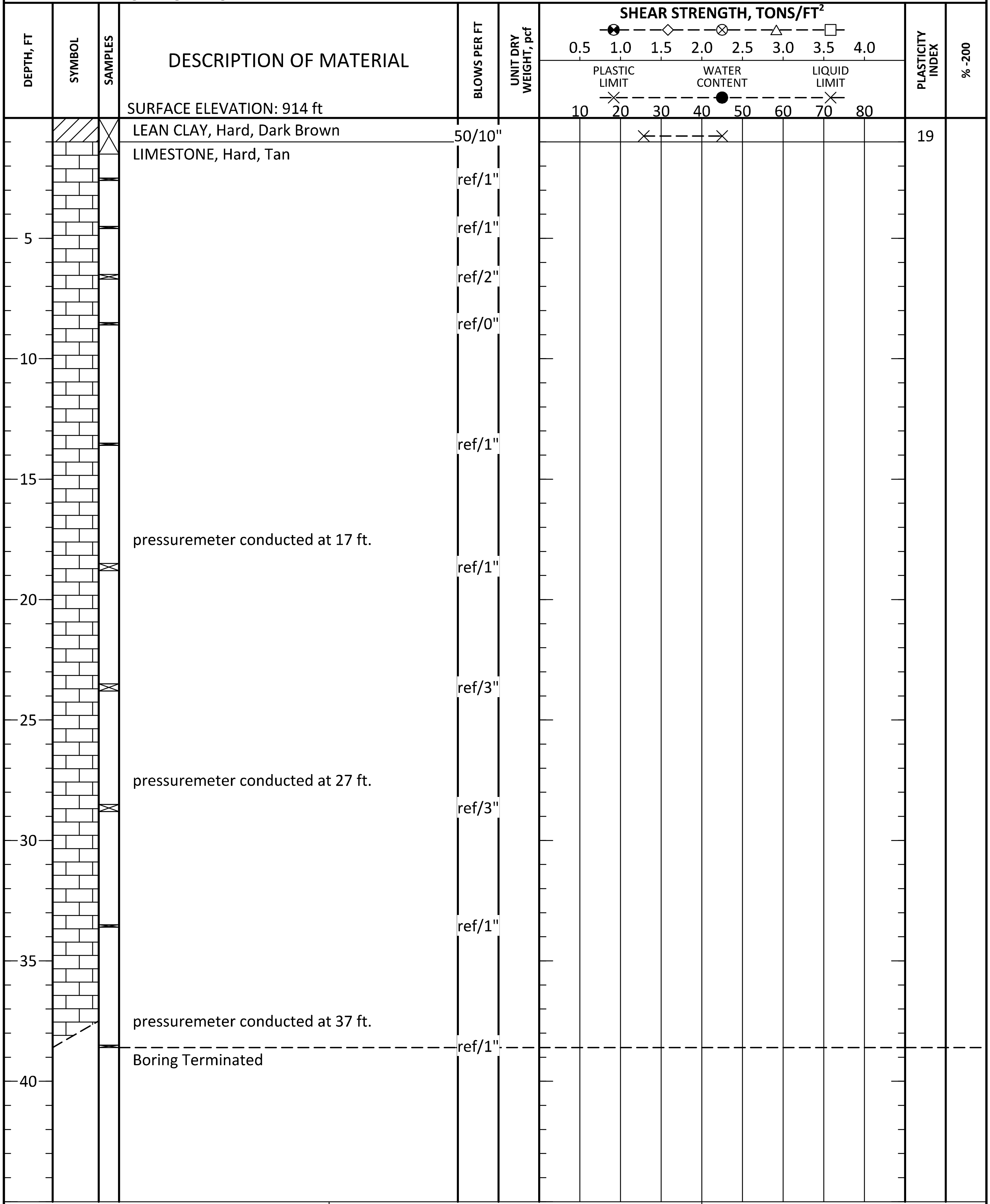
LOG OF BORING NO. H-14

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46333; W 98.71314



SURFACE ELEVATION: 914 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
LEAN CLAY, Hard, Dark Brown	50/10"		19	
LIMESTONE, Hard, Tan				
	ref/1"			
	ref/1"			
	ref/2"			
	ref/0"			
	ref/1"			
pressuremeter conducted at 17 ft.				
	ref/1"			
	ref/3"			
pressuremeter conducted at 27 ft.				
	ref/3"			
	ref/1"			
pressuremeter conducted at 37 ft.				
	ref/1"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	38.6 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/9/2022	**DATE MEASURED:**	5/9/2022	**FIGURE:**	15

LOG OF BORING NO. H-15

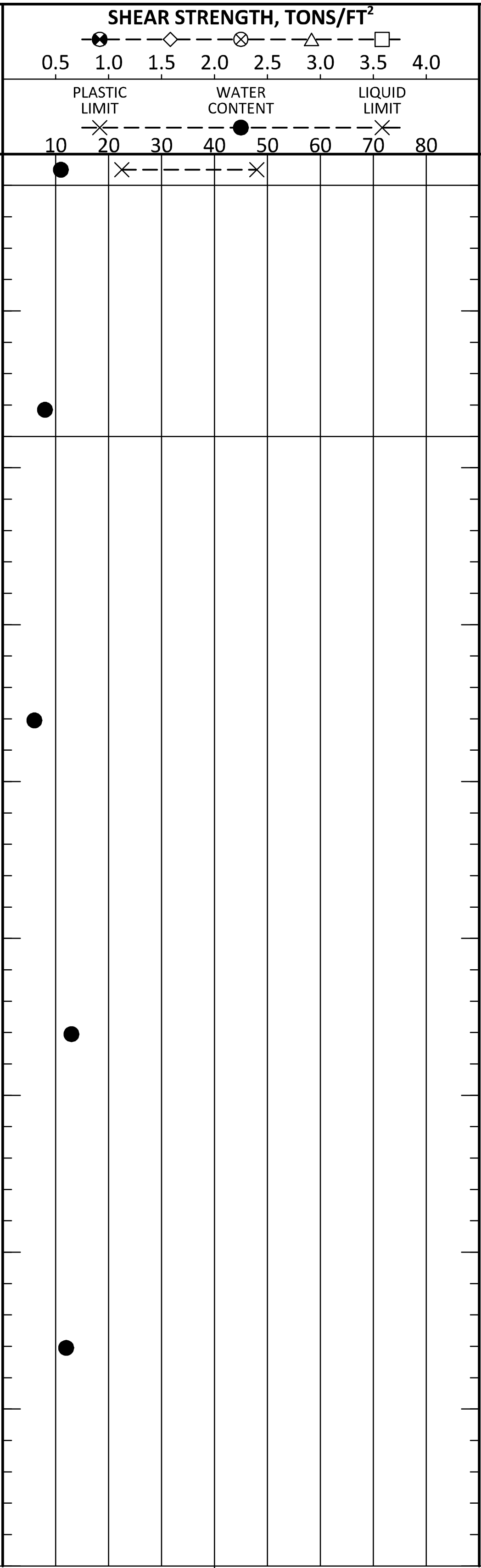
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46337; W 98.71388

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: 902 ft				
			LEAN CLAY, Dark Brown			26	
			LEAN CLAY, Hard, Reddish Brown, with limestone seams				
				100/3"			
5							
				100/1.5"			
			LIMESTONE, Hard, Tan				
10							
				100/1"			
15							
				100/1"			
20							
				100/1"			
25							
				100/1"			
30							
				100/1"			
35							
				100/1"			
40							
				100/1"			



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 55.0 ft
DATE DRILLED: 5/16/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/16/2022

PROJ. No.: ASA21-058-02
FIGURE: 16a

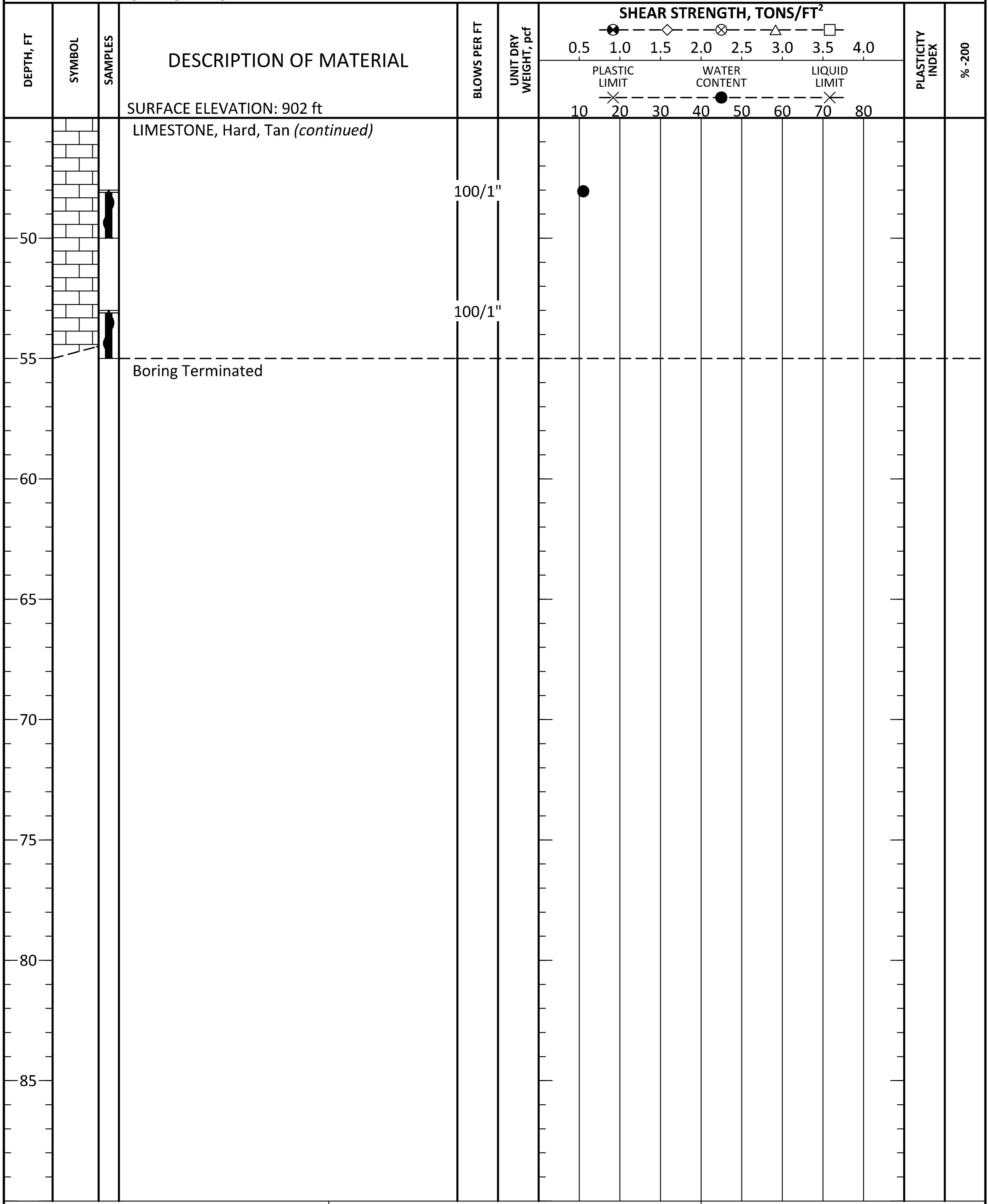
LOG OF BORING NO. H-15

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46337; W 98.71388



LIMESTONE, Hard, Tan *(continued)*

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	55.0 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/16/2022	**DATE MEASURED:**	5/16/2022	**FIGURE:**	16b

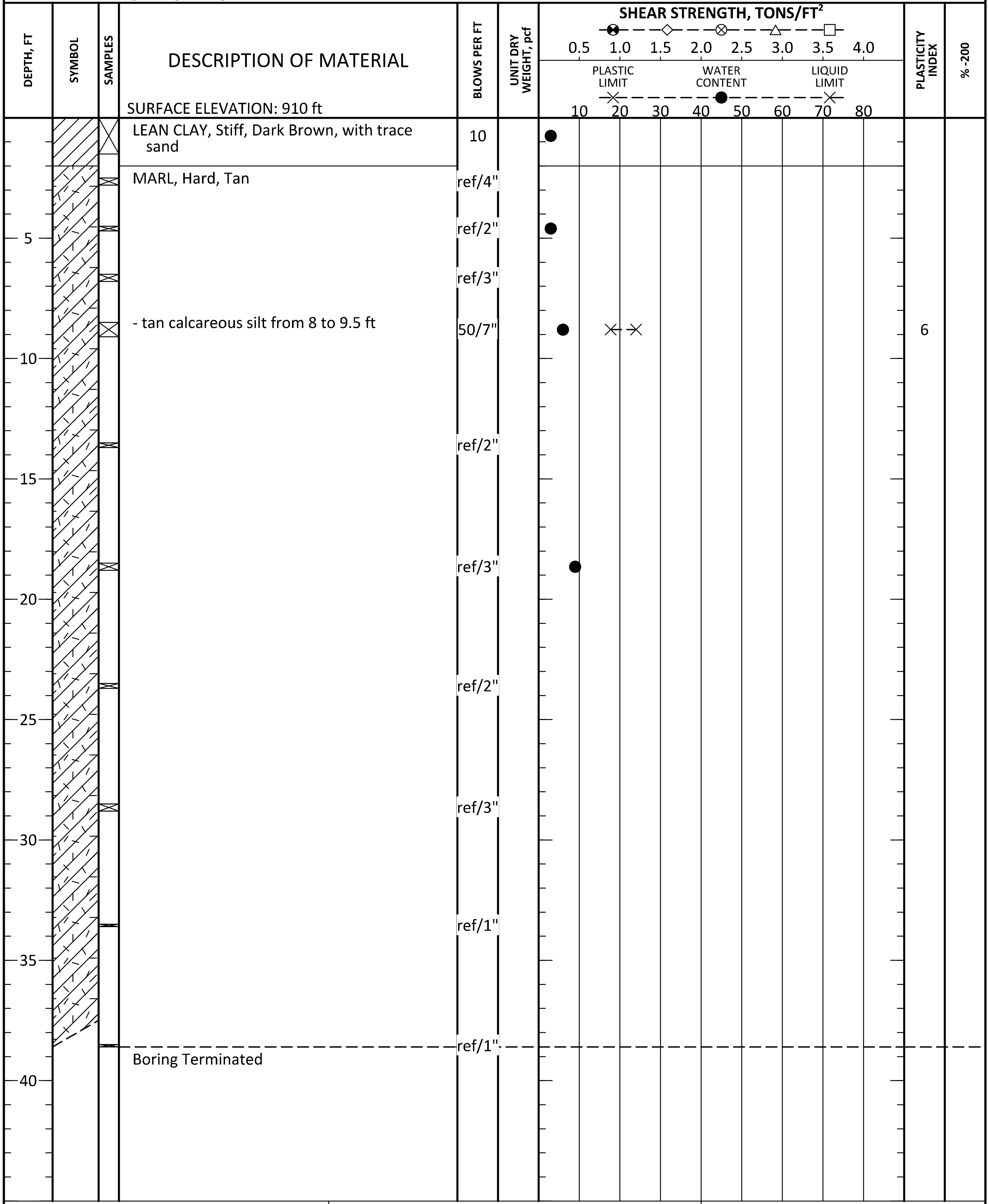
LOG OF BORING NO. H-16

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46330; W 98.71333



LEAN CLAY, Stiff, Dark Brown, with trace sand

MARL, Hard, Tan

- tan calcareous silt from 8 to 9.5 ft

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	38.6 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	4/20/2022	**DATE MEASURED:**	4/20/2022	**FIGURE:**	17

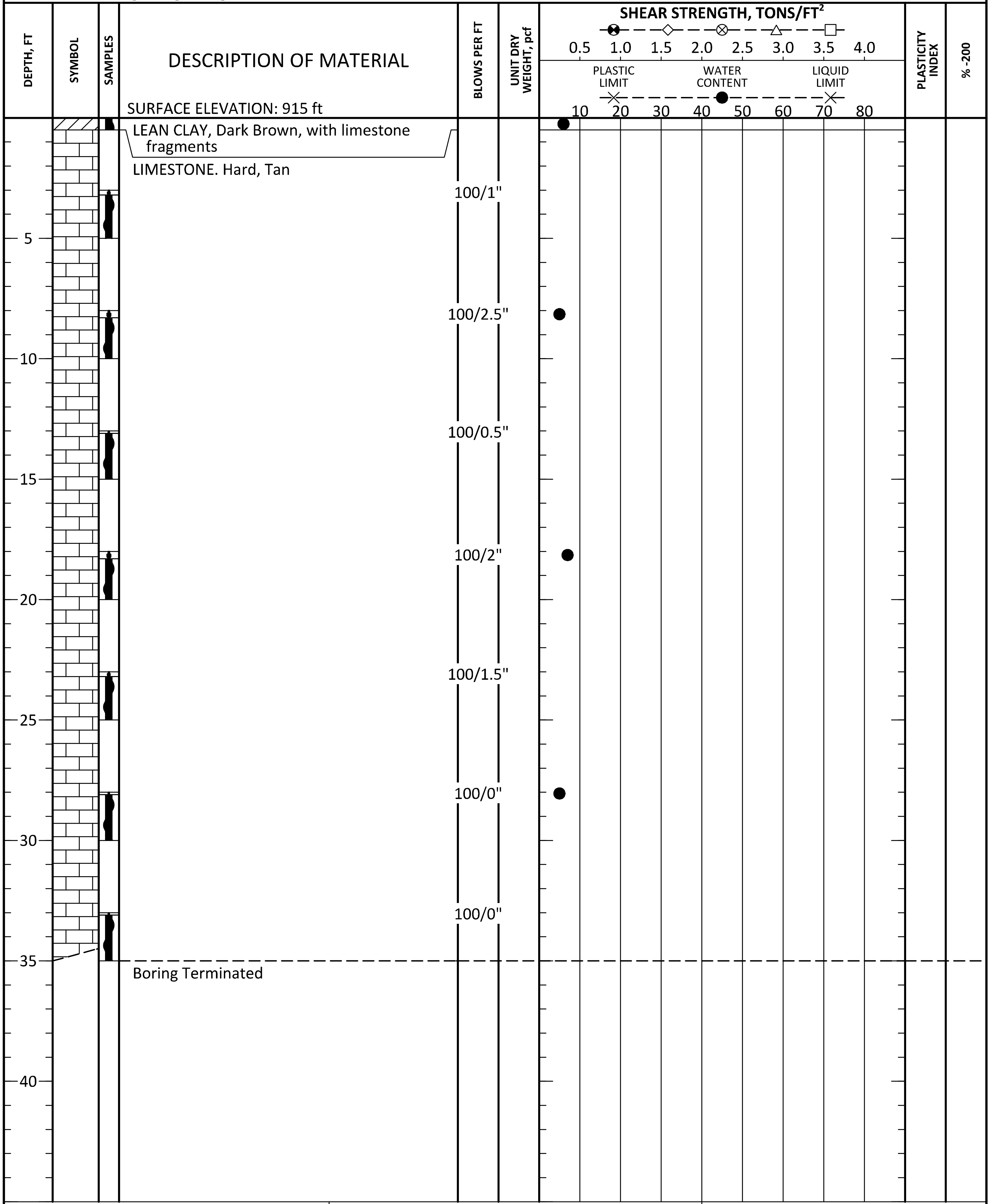
LOG OF BORING NO. MB1-1

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46303; W 98.71330



DESCRIPTION OF MATERIAL

SURFACE ELEVATION: 915 ft

LEAN CLAY, Dark Brown, with limestone fragments

LIMESTONE. Hard, Tan

Boring Terminated

BLOWS PER FT
100/1"
100/2.5"
100/0.5"
100/2"
100/1.5"
100/0"
100/0"

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 35.0 ft
DATE DRILLED: 5/13/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/13/2022
PROJ. No.: ASA21-058-02
FIGURE: 18

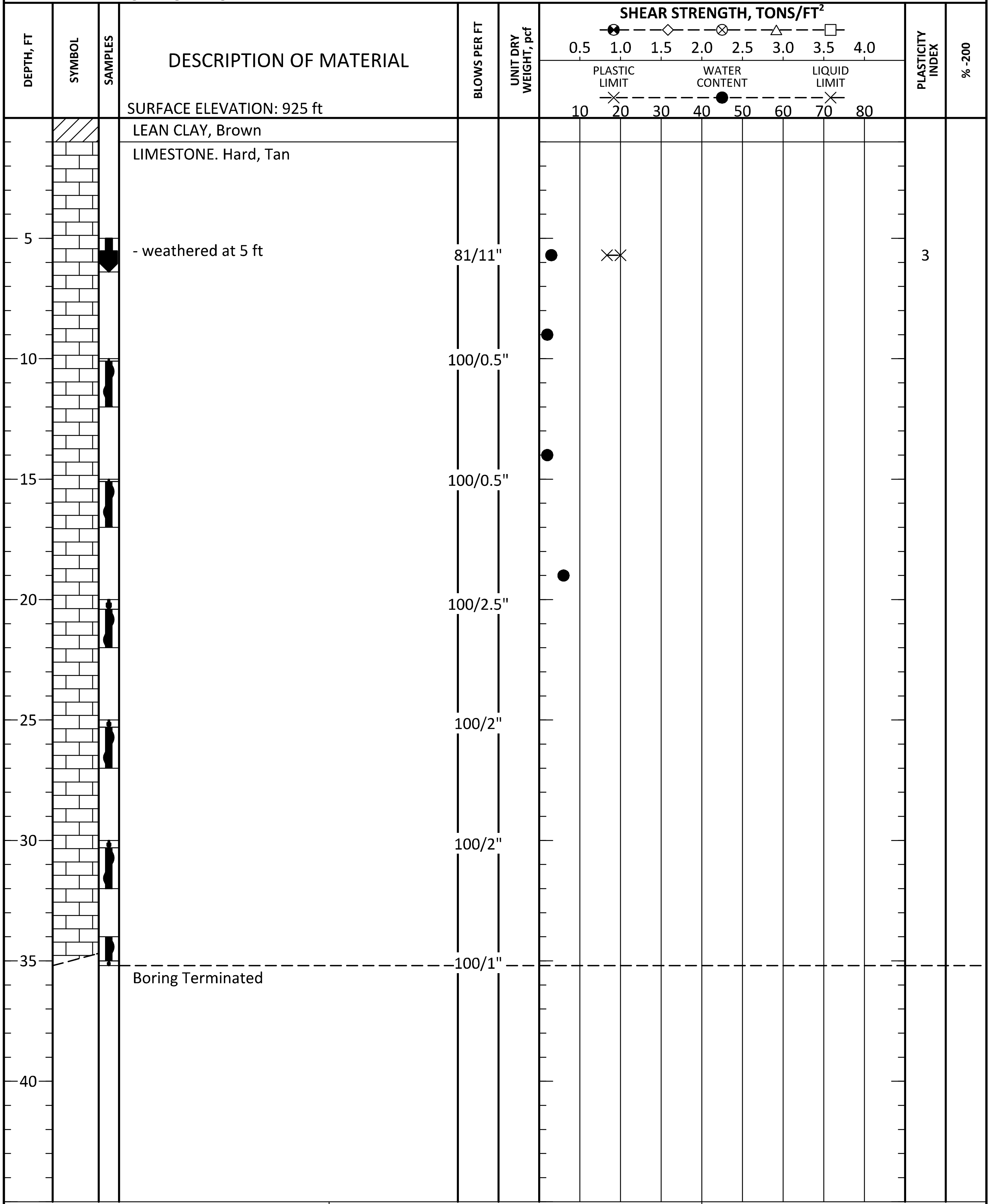
LOG OF BORING NO. MB1-2

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46301; W 98.71291



SURFACE ELEVATION: 925 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	LEAN CLAY, Brown				
	LIMESTONE. Hard, Tan				
5	- weathered at 5 ft	81/11"		3	
10		100/0.5"			
15		100/0.5"			
20		100/2.5"			
25		100/2"			
30		100/2"			
35		100/1"			
	Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 35.2 ft
DATE DRILLED: 5/19/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/19/2022

PROJ. No.: ASA21-058-02
FIGURE: 19

LOG OF BORING NO. MB1-3

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46281; W 98.71317

SURFACE ELEVATION: 928 ft

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70 80

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	FAT CLAY, Hard, Dark Brown	50/5"			
	LIMESTONE, Hard, Tan				
		50/2"			
5	MARL, Hard, Tan	50/4"			
		50/4"			
		ref/2"			
10					
	pressuremeter conducted at 12 ft.				
15		50/2"			
20		50/2"			
	pressuremeter conducted at 23 ft.				
25		50/3"			
30		50/2"			
	pressuremeter conducted at 33 ft.				
35		ref/1"			
	Boring Terminated				
40					

DEPTH DRILLED: 35.1 ft
DATE DRILLED: 5/13/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/13/2022

PROJ. No.: ASA21-058-02
FIGURE: 20

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. MB1-4

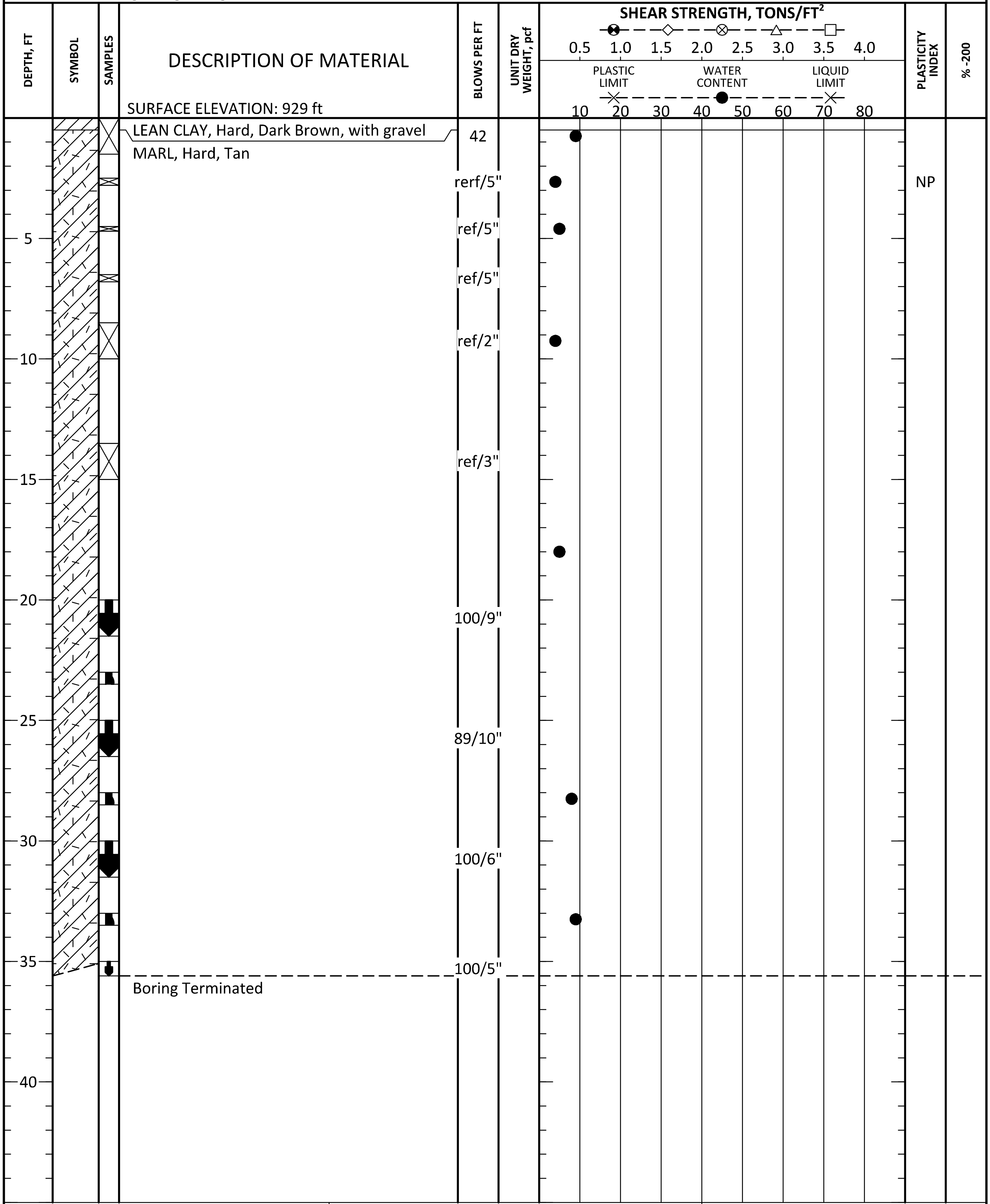
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46270; W 98.71326

SURFACE ELEVATION: 929 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
LEAN CLAY, Hard, Dark Brown, with gravel	42	
MARL, Hard, Tan		
	rerf/5"	NP
	ref/5"	
	ref/5"	
	ref/2"	
	ref/3"	
	100/9"	
	89/10"	
	100/6"	
	100/5"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 35.6 ft
DATE DRILLED: 5/4/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022
PROJ. No.: ASA21-058-02
FIGURE: 21

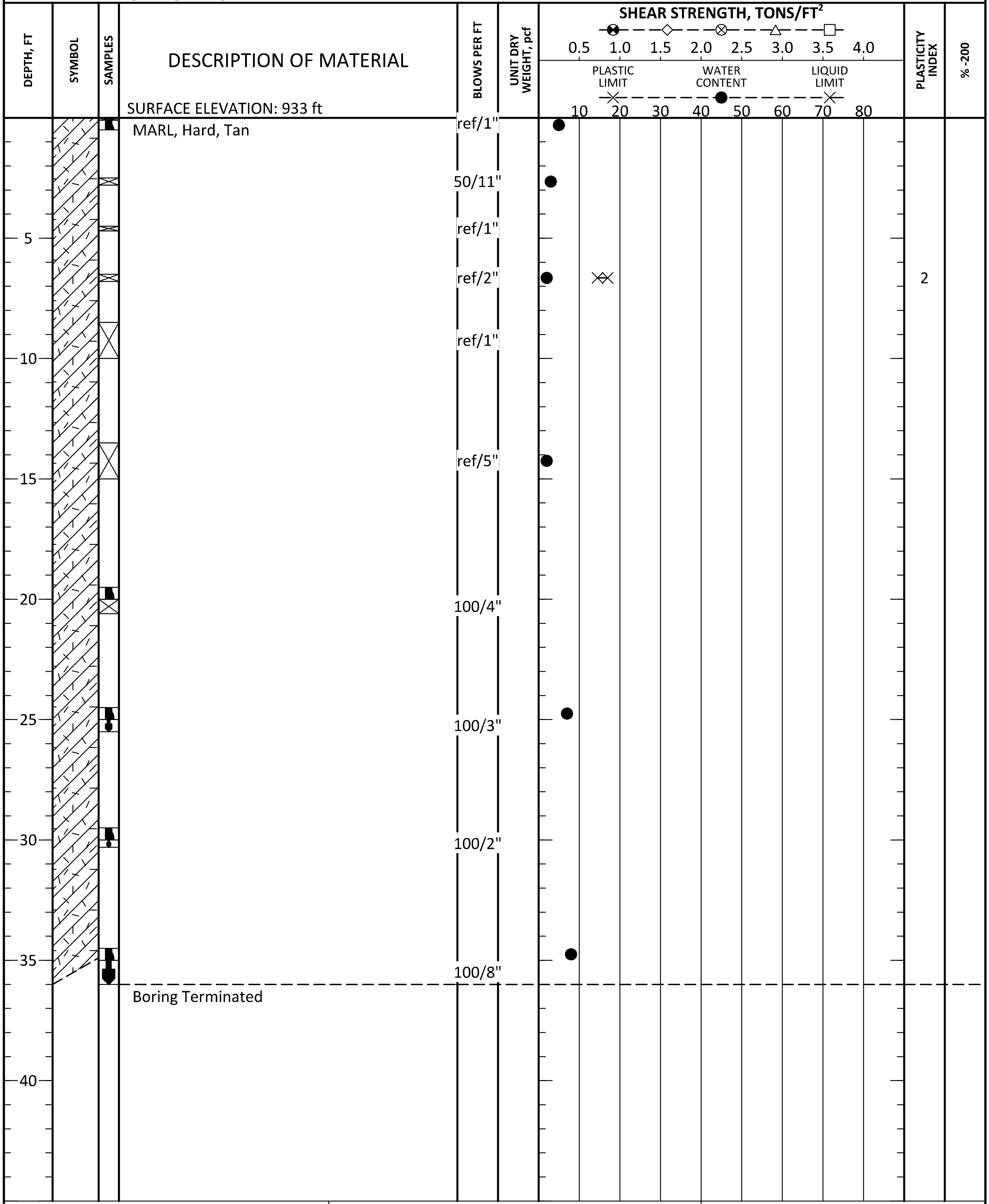
LOG OF BORING NO. MB1-5

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46277; W 98.71303



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 36.0 ft
DATE DRILLED: 5/5/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/5/2022

PROJ. No.: ASA21-058-02
FIGURE: 22

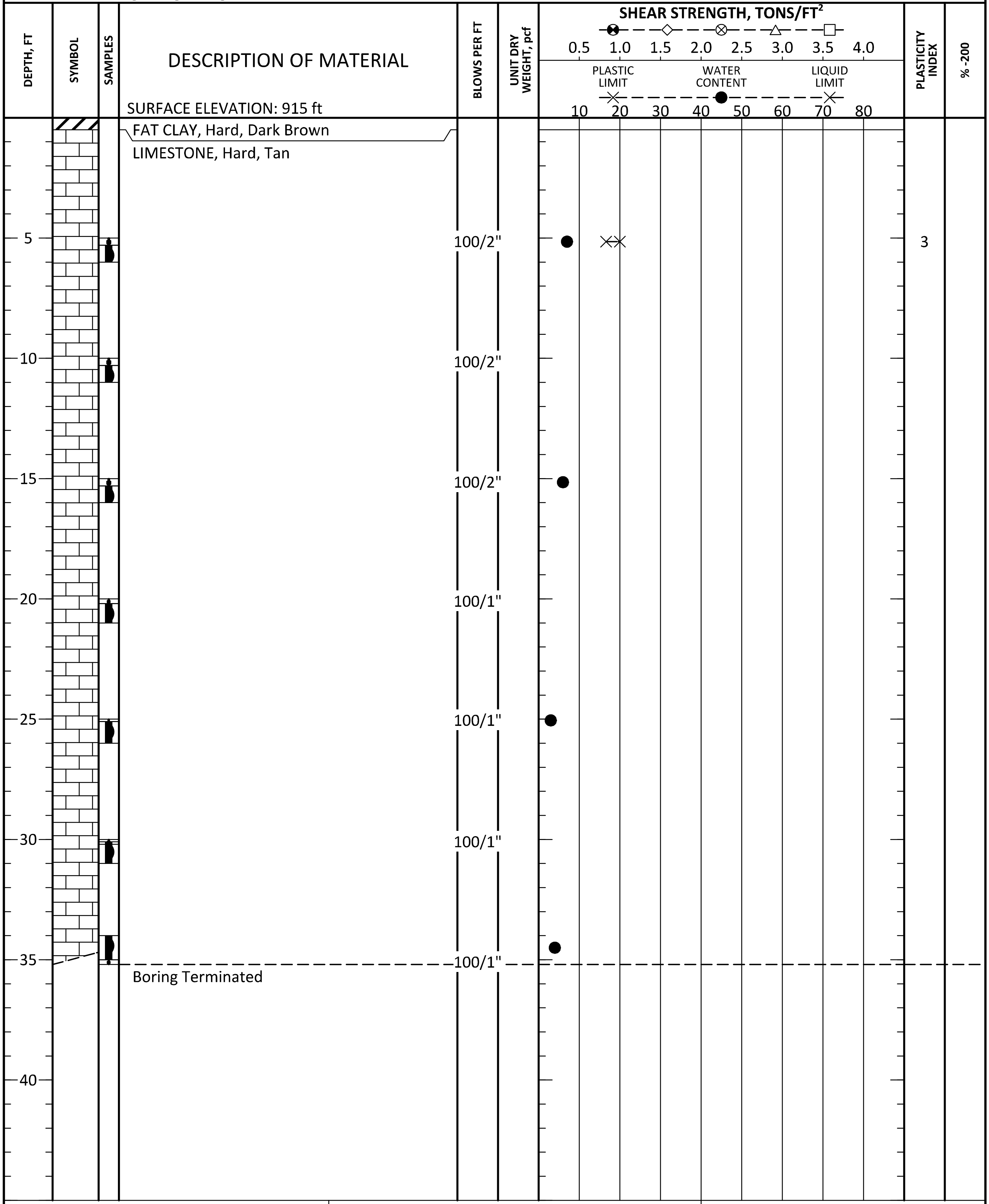
LOG OF BORING NO. MB2-1

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46117; W 98.71305



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	35.2 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/24/2022	**DATE MEASURED:**	5/24/2022	**FIGURE:**	23

LOG OF BORING NO. MB2-2

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46153; W 98.71315

SURFACE ELEVATION: 907 ft

SHEAR STRENGTH, TONS/FT^2
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70 80

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2	PLASTICITY INDEX	% -200
			LEAN CLAY, Calcareous, Very Stiff to Hard, Tan	26				
				50/9"				
5			MARL, Hard, Tan	50/5"				
				50/1"				
				ref/2"				
10								
				ref/3"				
15								
				ref/5"				
20			FAT CLAY, Hard, Tan					
				50/6"				
25								
			MARL, Hard, Tan	50/5"				
30								
			Boring Terminated	ref/1"				
35								
40								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 33.6 ft
DATE DRILLED: 5/17/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/17/2022

PROJ. No.: ASA21-058-02
FIGURE: 24

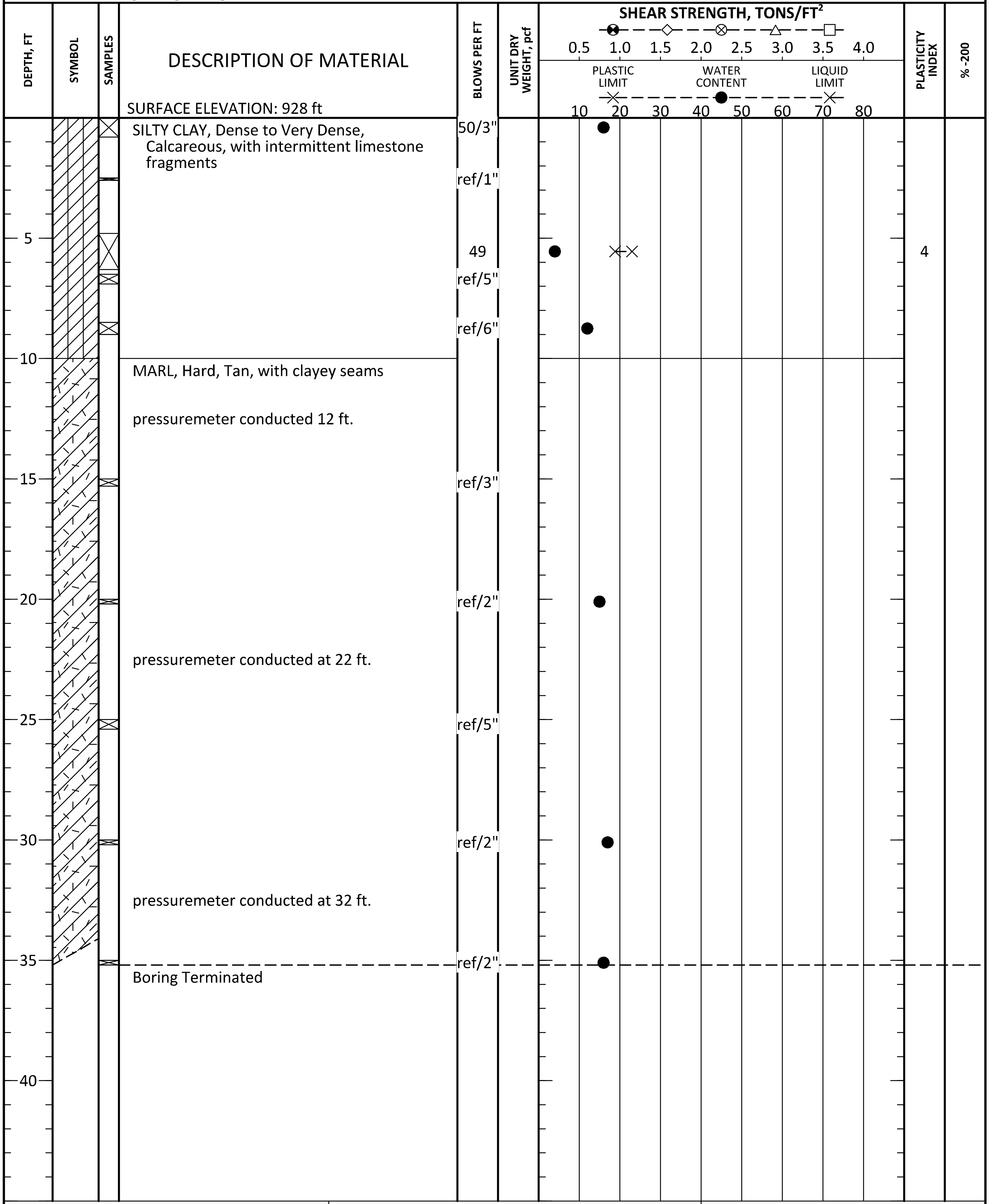
LOG OF BORING NO. MB2-3

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46206; W 98.71325



SILTY CLAY, Dense to Very Dense, Calcareous, with intermittent limestone fragments

MARL, Hard, Tan, with clayey seams

pressuremeter conducted 12 ft.

pressuremeter conducted at 22 ft.

pressuremeter conducted at 32 ft.

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	35.2 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/18/2022	**DATE MEASURED:**	5/18/2022	**FIGURE:**	25

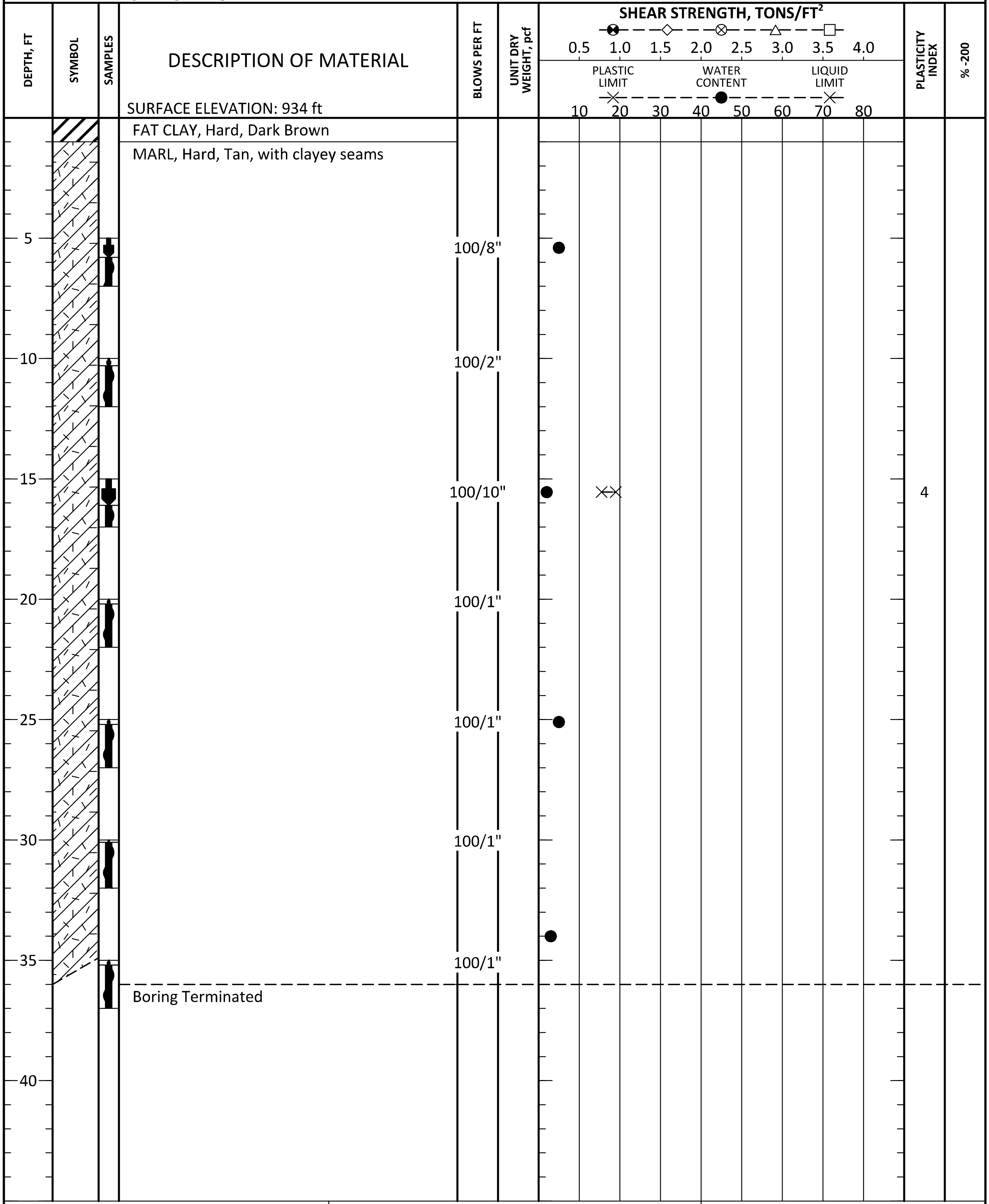
LOG OF BORING NO. MB2-4

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46236; W 98.71309



SURFACE ELEVATION: 934 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
0	FAT CLAY, Hard, Dark Brown		
1	MARL, Hard, Tan, with clayey seams		
5		100/8"	
10		100/2"	
15		100/10"	4
20		100/1"	
25		100/1"	
30		100/1"	
35		100/1"	
36	Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 36.0 ft
DATE DRILLED: 5/24/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/24/2022
PROJ. No.: ASA21-058-02
FIGURE: 26

LOG OF BORING NO. MB2-5

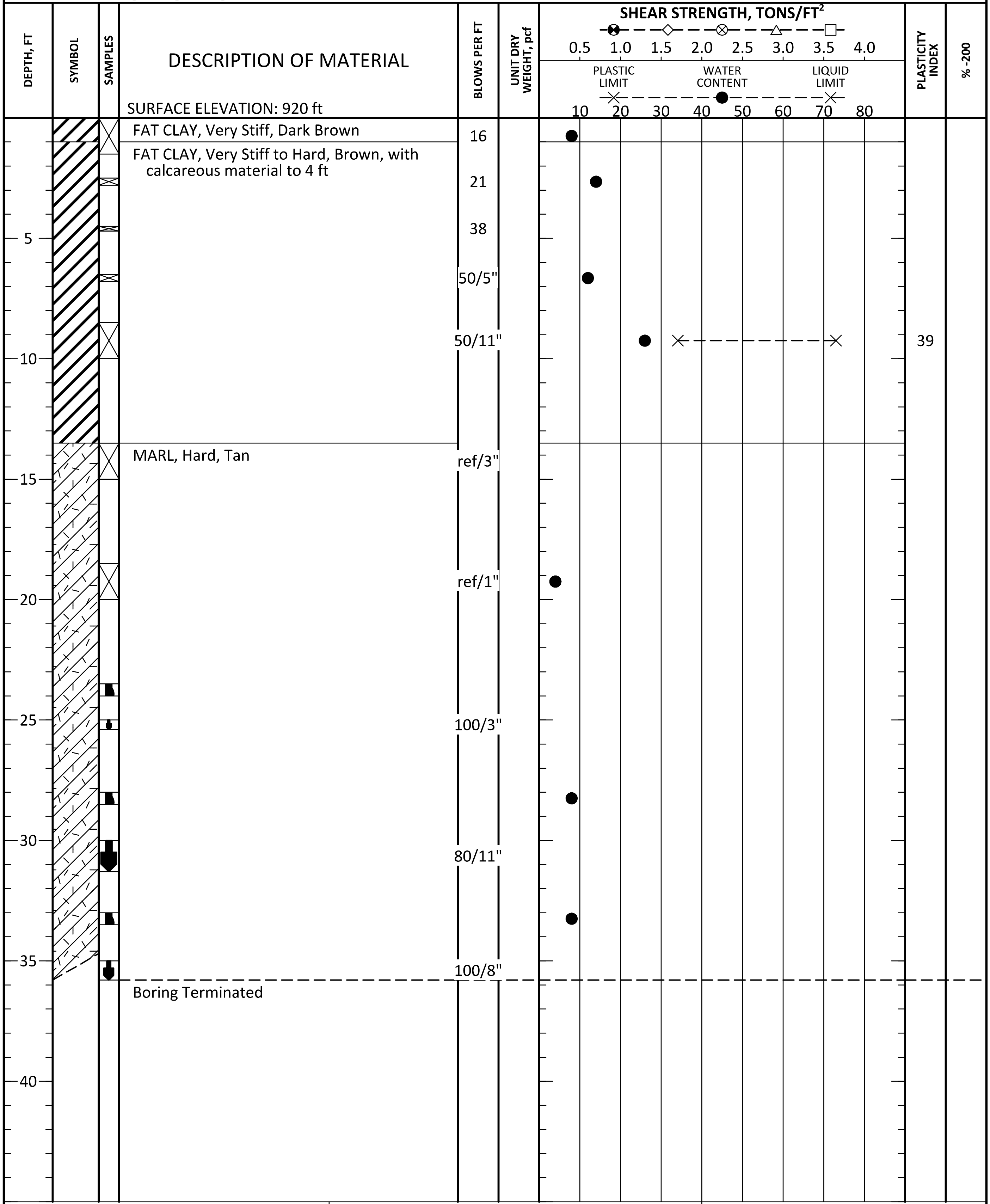
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46278; W 98.71383

SURFACE ELEVATION: 920 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
FAT CLAY, Very Stiff, Dark Brown	16	
FAT CLAY, Very Stiff to Hard, Brown, with calcareous material to 4 ft	21	
	38	
	50/5"	
	50/11"	39
MARL, Hard, Tan	ref/3"	
	ref/1"	
	100/3"	
	80/11"	
	100/8"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 35.8 ft
DATE DRILLED: 5/4/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022

PROJ. No.: ASA21-058-02
FIGURE: 27

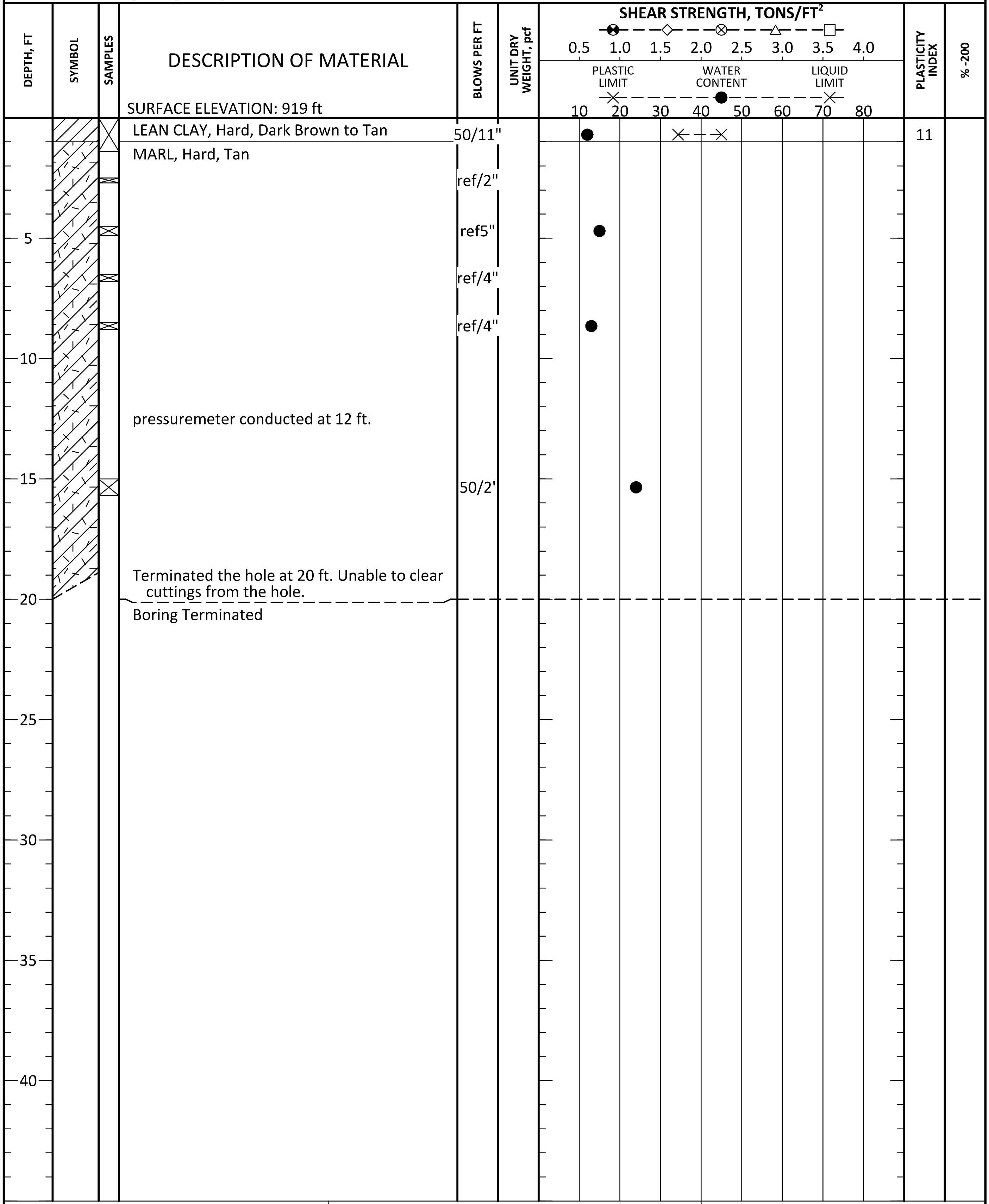
LOG OF BORING NO. MB2-6

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46283; W 98.71367



LEAN CLAY, Hard, Dark Brown to Tan

MARL, Hard, Tan

pressuremeter conducted at 12 ft.

Terminated the hole at 20 ft. Unable to clear cuttings from the hole.

Boring Terminated

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 5/18/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/18/2022

PROJ. No.: ASA21-058-02
FIGURE: 28

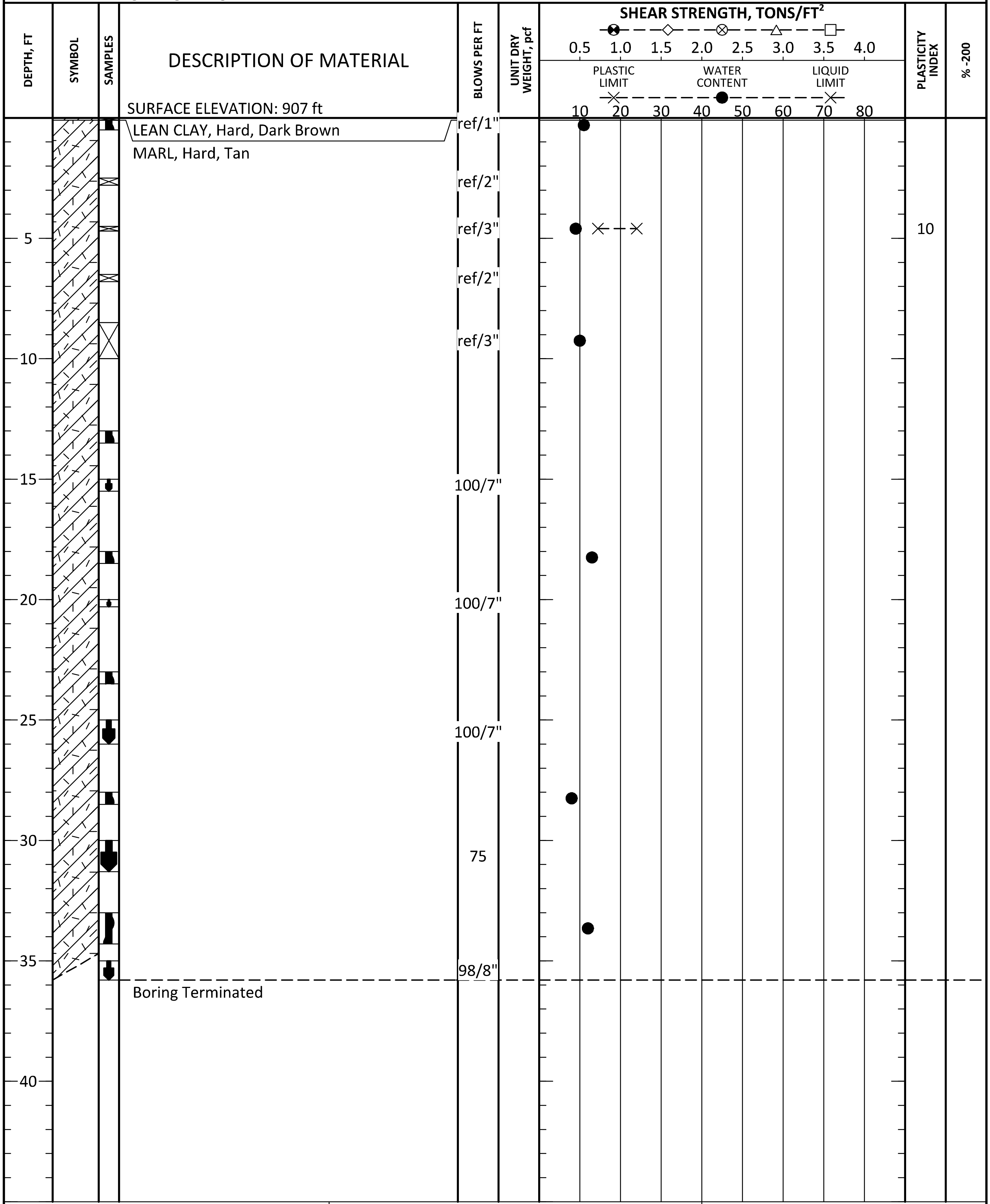
LOG OF BORING NO. MB2-7

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46294; W 98.71386



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	35.8 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/5/2022	**DATE MEASURED:**	5/5/2022	**FIGURE:**	29

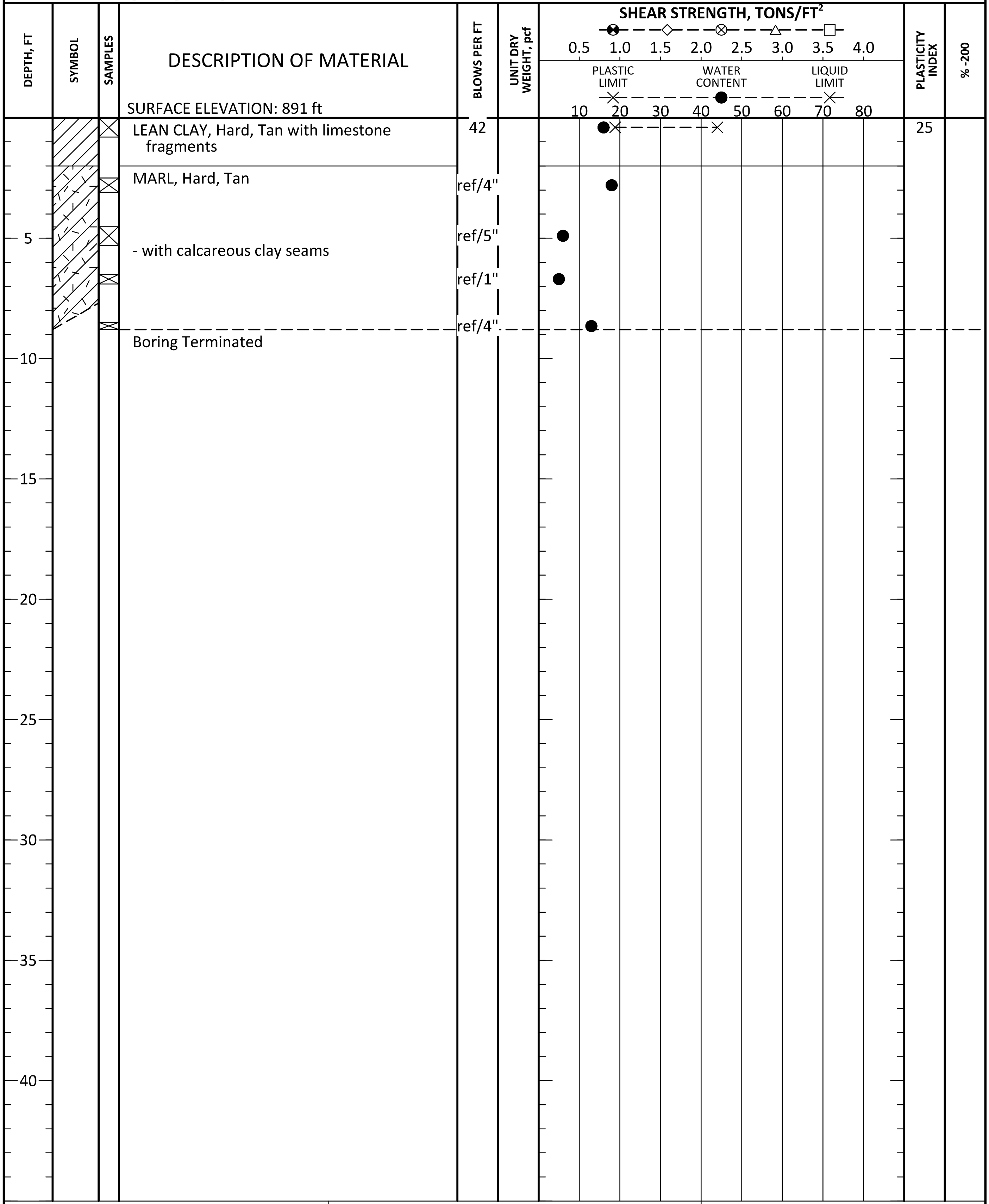
LOG OF BORING NO. P-1

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46520; W 98.71426



DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: 891 ft				
			LEAN CLAY, Hard, Tan with limestone fragments	42		25	
			MARL, Hard, Tan	ref/4"			
5			- with calcareous clay seams	ref/5"			
				ref/1"			
				ref/4"			
			Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	8.8 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/5/2022	**DATE MEASURED:**	5/5/2022	**FIGURE:**	30

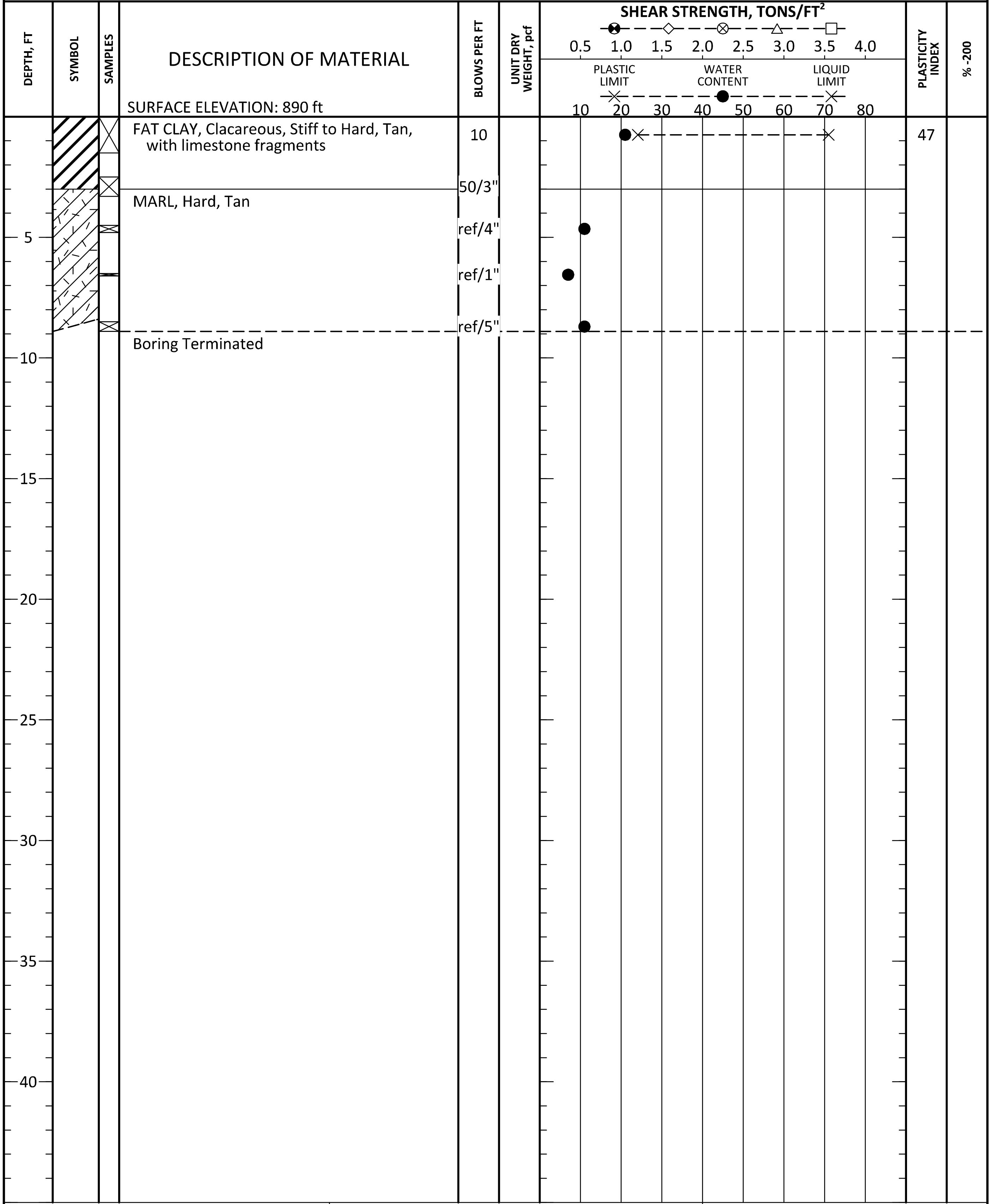
LOG OF BORING NO. P-2

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46474; W 98.71471



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
SURFACE ELEVATION: 890 ft				
FAT CLAY, Clacareous, Stiff to Hard, Tan, with limestone fragments	10		47	
	50/3"			
MARL, Hard, Tan	ref/4"			
	ref/1"			
	ref/5"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.9 ft
DATE DRILLED: 5/4/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/4/2022

PROJ. No.: ASA21-058-02
FIGURE: 31

LOG OF BORING NO. P-3

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

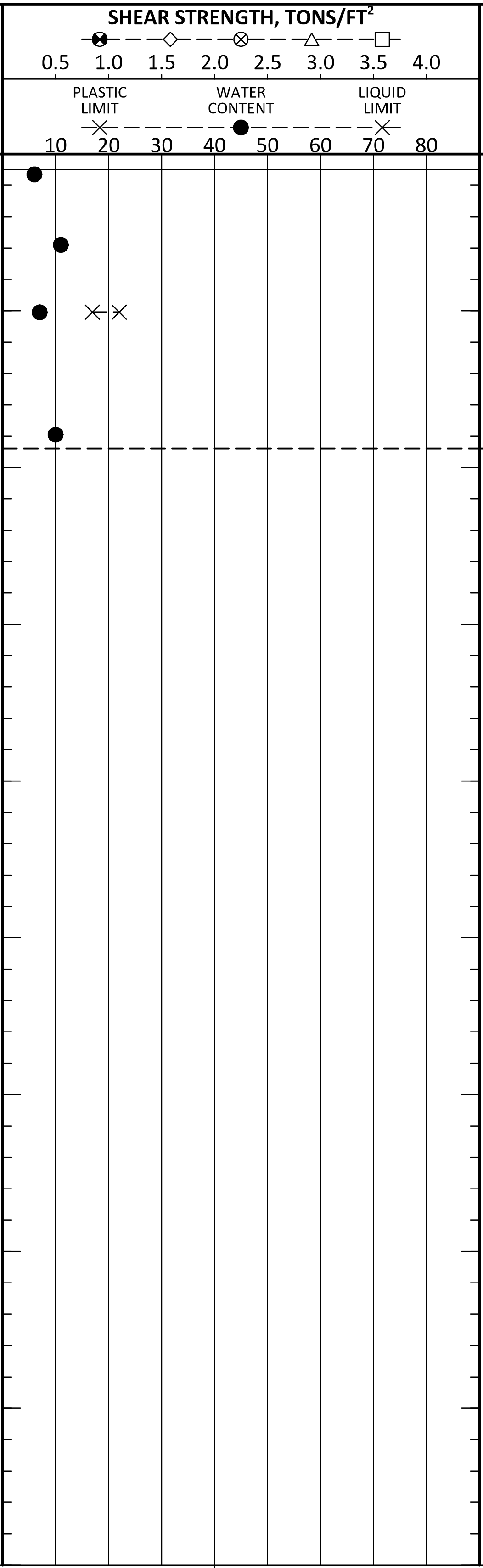
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46412; W 98.71589

SURFACE ELEVATION: 905 ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
			LEAN CLAY, Clacareous, Hard, Tan, with limestone fragments	50/10"			
			MARL, Hard, Tan				
				50/4"			
5				50/7"		5	
				ref/3"			
				50/5"			
10			Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 9.4 ft
DATE DRILLED: 5/23/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022

PROJ. No.: ASA21-058-02
FIGURE: 32

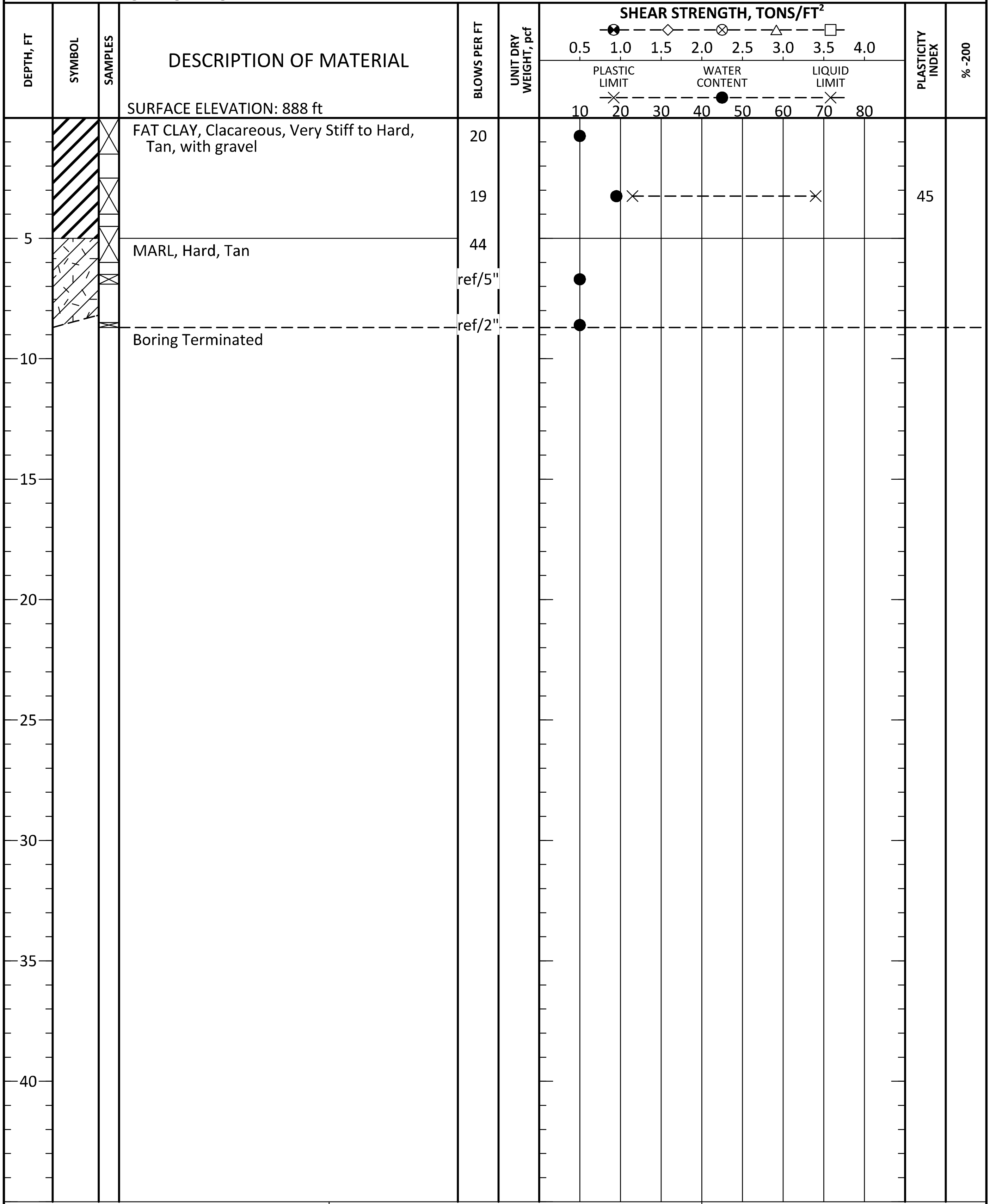
LOG OF BORING NO. P-4

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46410; W 98.07151



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
SURFACE ELEVATION: 888 ft		
FAT CLAY, Clacareous, Very Stiff to Hard, Tan, with gravel	20	
	19	45
MARL, Hard, Tan	44	
	ref/5"	
	ref/2"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	8.7 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/23/2022	**DATE MEASURED:**	5/23/2022	**FIGURE:**	33

LOG OF BORING NO. P-5

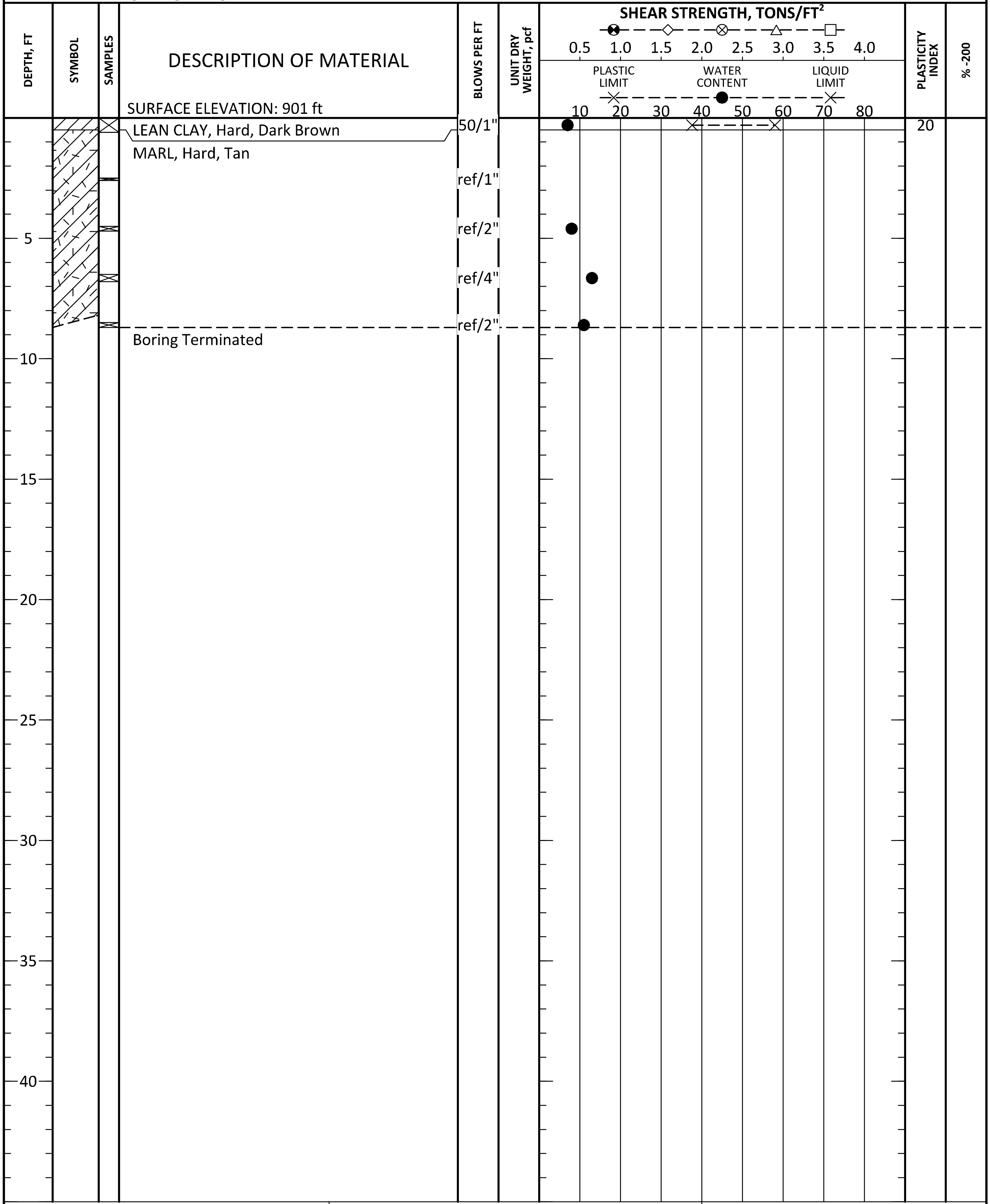
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46368; W 98.71404

SURFACE ELEVATION: 901 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
LEAN CLAY, Hard, Dark Brown	50/1"		20	
MARL, Hard, Tan				
	ref/1"			
	ref/2"			
	ref/4"			
	ref/2"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.7 ft
DATE DRILLED: 5/23/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022
PROJ. No.: ASA21-058-02
FIGURE: 34

LOG OF BORING NO. P-6

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

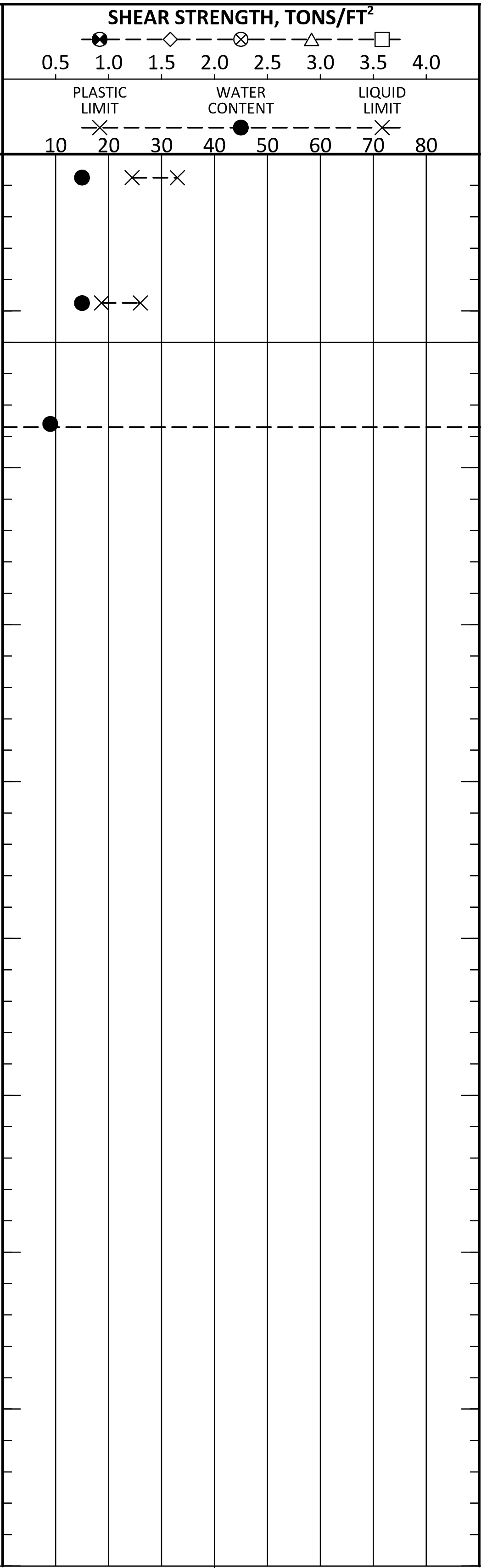
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46448; W 98.71355

SURFACE ELEVATION: 909 ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
			LEAN CLAY, Hard, Calcareous, Tan	40		9	
				50			
5				50/6"		7	
			LIMESTONE. Hard, Tan	ref/1"			
				ref/2"			
			Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.7 ft
DATE DRILLED: 5/5/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/5/2022

PROJ. No.: ASA21-058-02
FIGURE: 35

LOG OF BORING NO. P-7

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

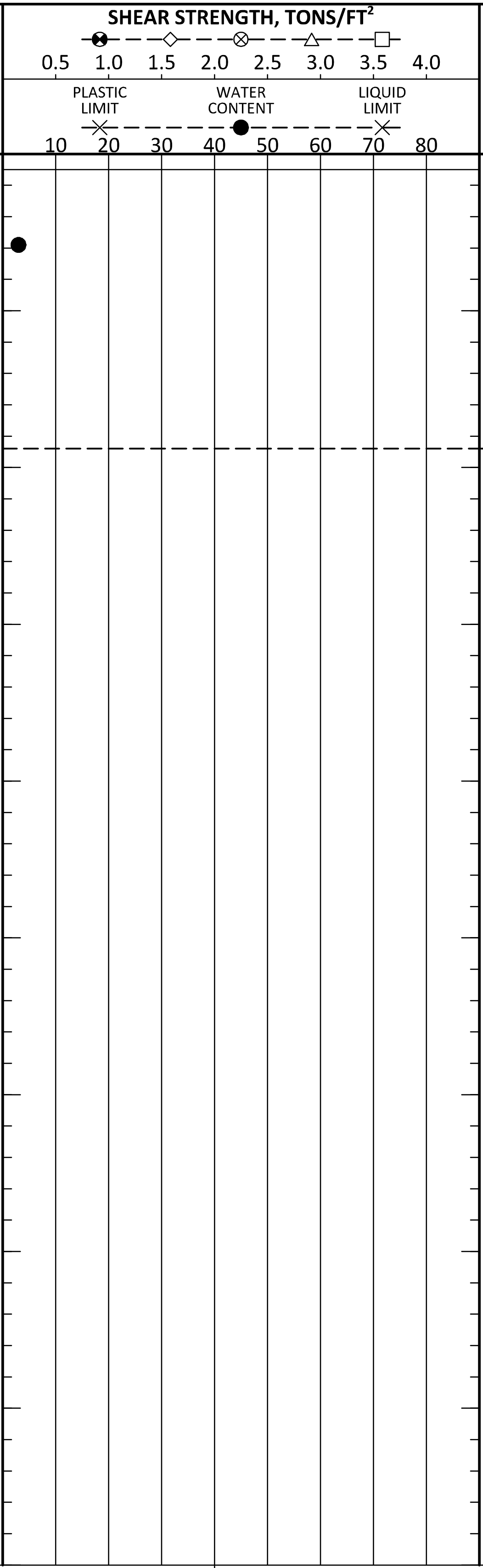
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46391; W 98.71245

SURFACE ELEVATION: 940 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
0	LEAN CLAY, Hard, Calcareous, Tan	50/8"			
	MARL. Hard, Tan				
		50/4"			
5		ref/1"			
		ref/2"			
		50/5"			
10	Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 9.4 ft
DATE DRILLED: 5/23/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022
PROJ. No.: ASA21-058-02
FIGURE: 36

LOG OF BORING NO. RW-1

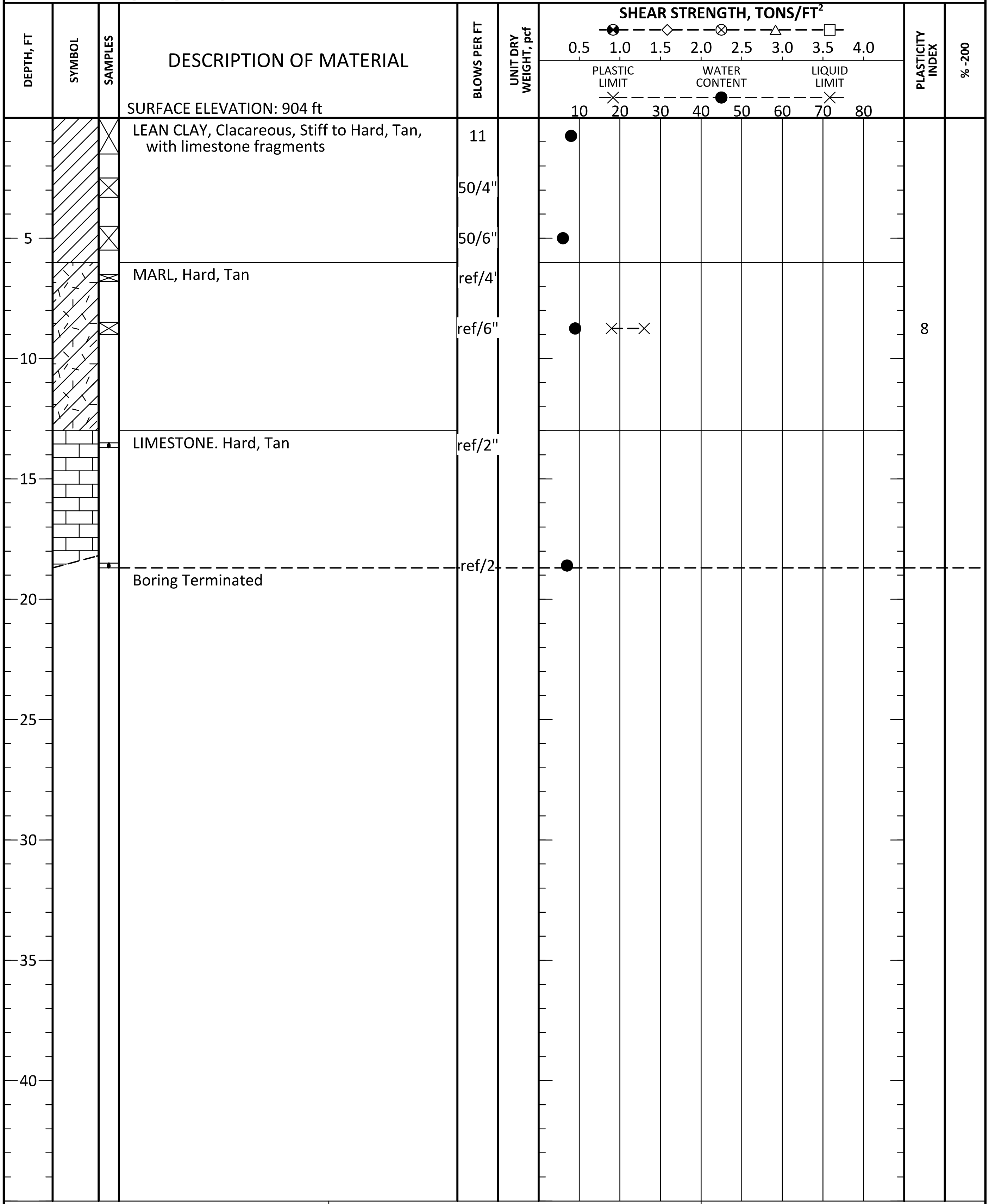
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46506; W 98.71334

SURFACE ELEVATION: 904 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
LEAN CLAY, Clacareous, Stiff to Hard, Tan, with limestone fragments	11	
	50/4"	
	50/6"	
MARL, Hard, Tan	ref/4"	
	ref/6"	8
LIMESTONE. Hard, Tan	ref/2"	
	ref/2	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 18.7 ft
DATE DRILLED: 5/5/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/5/2022

PROJ. No.: ASA21-058-02
FIGURE: 37

LOG OF BORING NO. RW-2

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

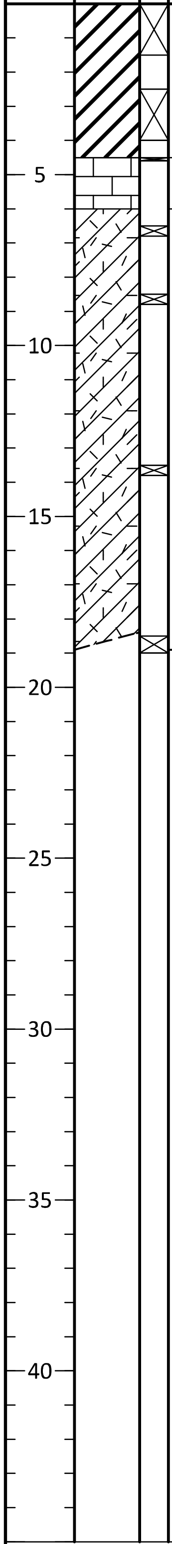
RABA KISTNER
TBPE Firm Registration No. F-3257

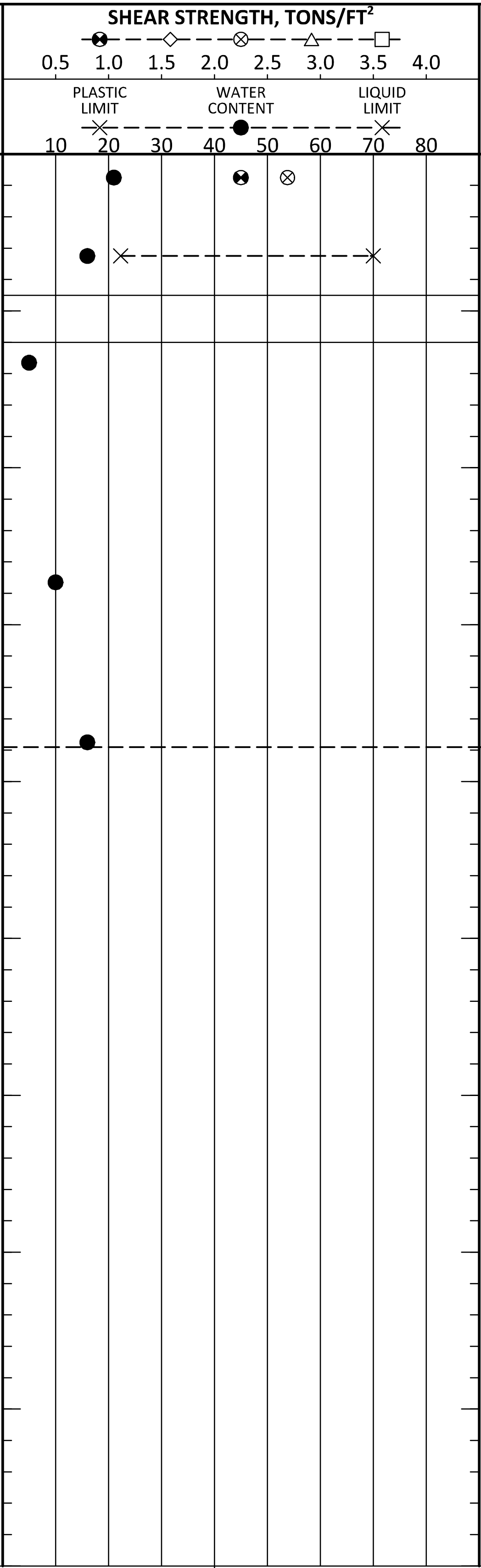
DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46510; W 98.71397

SURFACE ELEVATION: 898 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
FAT CLAY, Clacareous, Very Stiff , Reddish Brown, with trace sand		102		
	17		48	
	ref/1"			
LIMESTONE. Hard, Tan				
MARL, Hard, Tan	ref/4"			
	ref/4			
	ref/4"			
	ref/5"			
Boring Terminated				





DEPTH DRILLED: 18.9 ft
DATE DRILLED: 5/5/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/5/2022

PROJ. No.: ASA21-058-02
FIGURE: 38

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. RW-3

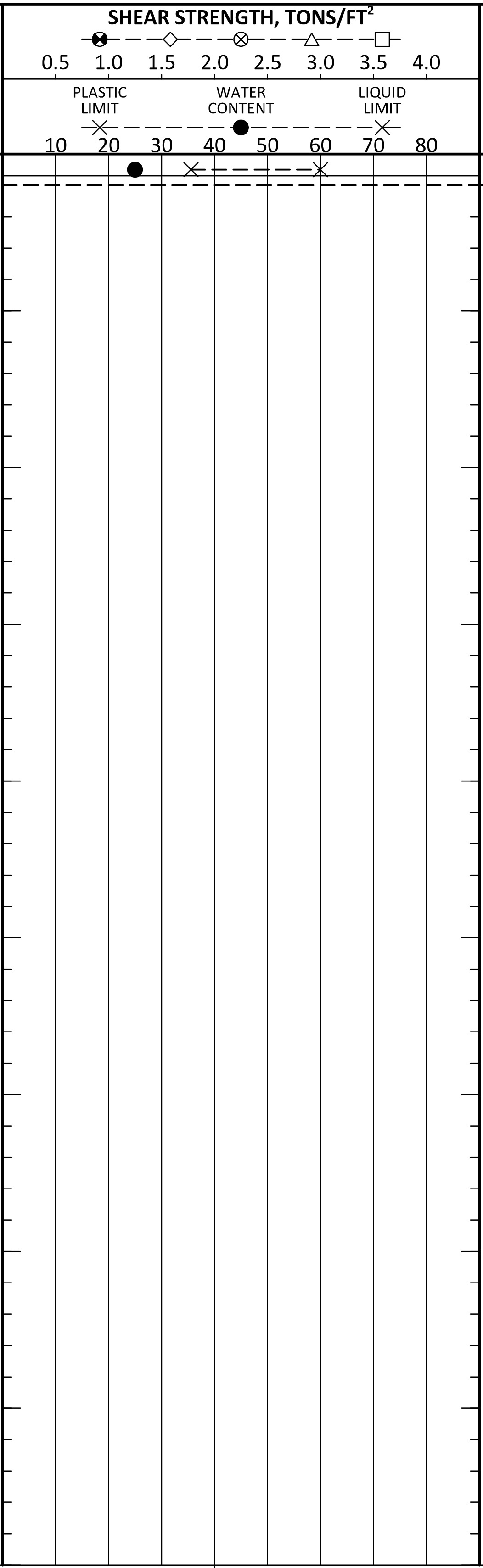
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46265; W 98.71231

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
			SURFACE ELEVATION: 936 ft				
	▨	■	FAT CLAY, Dark Brown			24	
			MARL, Hard, Tan				
			Boring Terminated				



DEPTH DRILLED: 1.0 ft
DATE DRILLED: 5/25/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/25/2022
PROJ. No.: ASA21-058-02
FIGURE: 39

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. RW-4

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

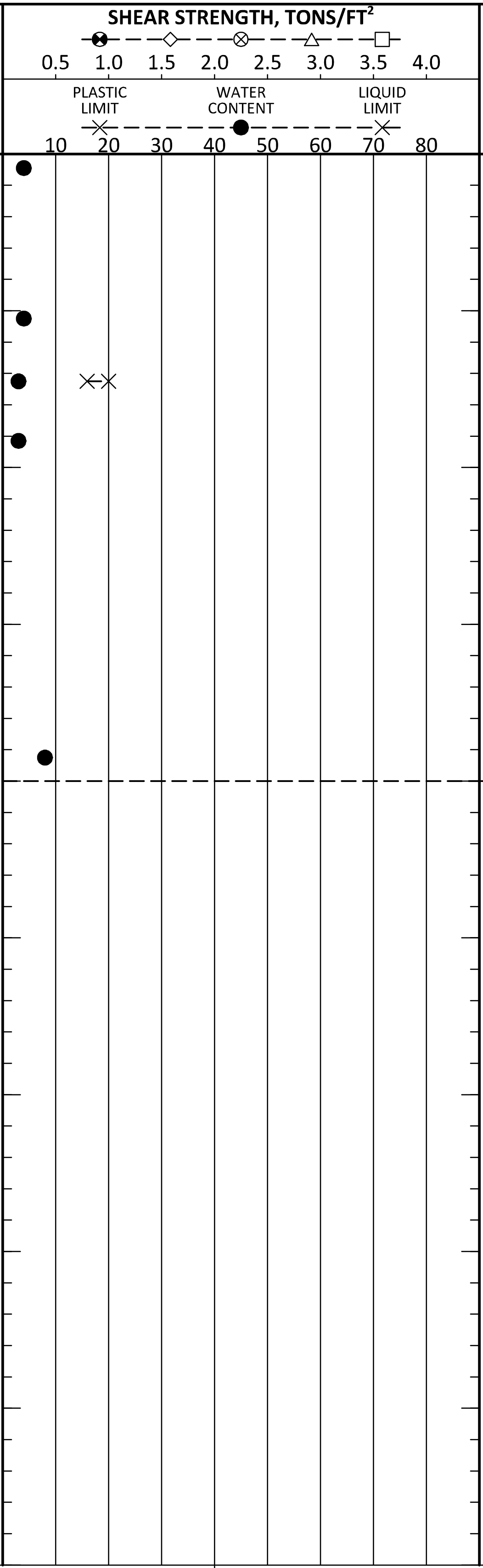
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46250; W 98.71230

SURFACE ELEVATION: 944 ft

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	▨	☒	LEAN CLAY, Marly, Very Stiff to Hard, Tan	50/5"			
		☒		50/8"			
5		☒		28			
		☒		27		4	
		☒		50/9"			
		☒		50/8"			
		☒		39			
20			Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 5/25/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/25/2022

PROJ. No.: ASA21-058-02
FIGURE: 40

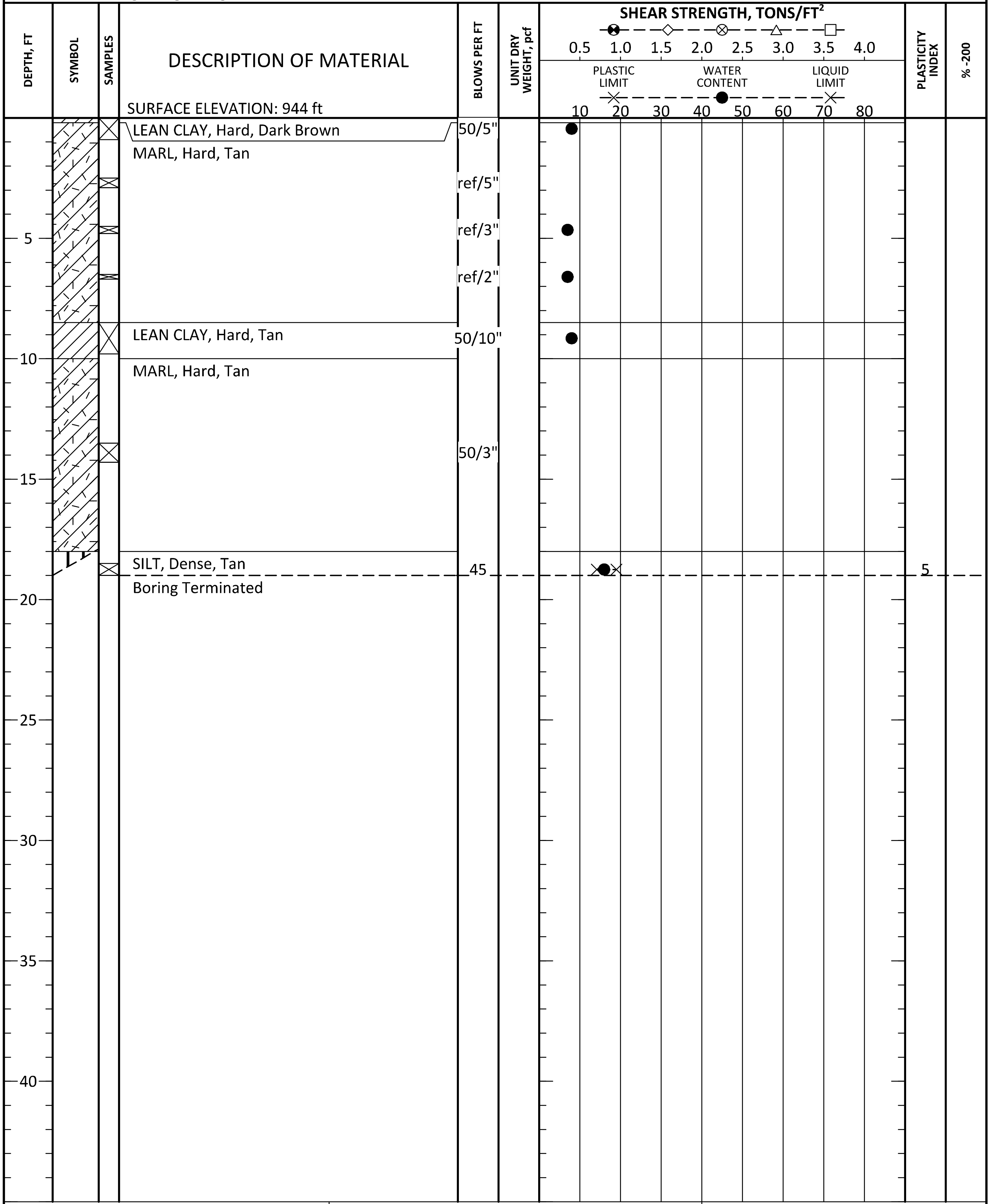
LOG OF BORING NO. RW-5

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46250; W 98.71230



SURFACE ELEVATION: 944 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
LEAN CLAY, Hard, Dark Brown	50/5"	
MARL, Hard, Tan	ref/5" ref/3" ref/2"	
LEAN CLAY, Hard, Tan	50/10"	
MARL, Hard, Tan	50/3"	
SILT, Dense, Tan	45	5
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 19.0 ft
DATE DRILLED: 5/25/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/25/2022

PROJ. No.: ASA21-058-02
FIGURE: 41

LOG OF BORING NO. RW-6

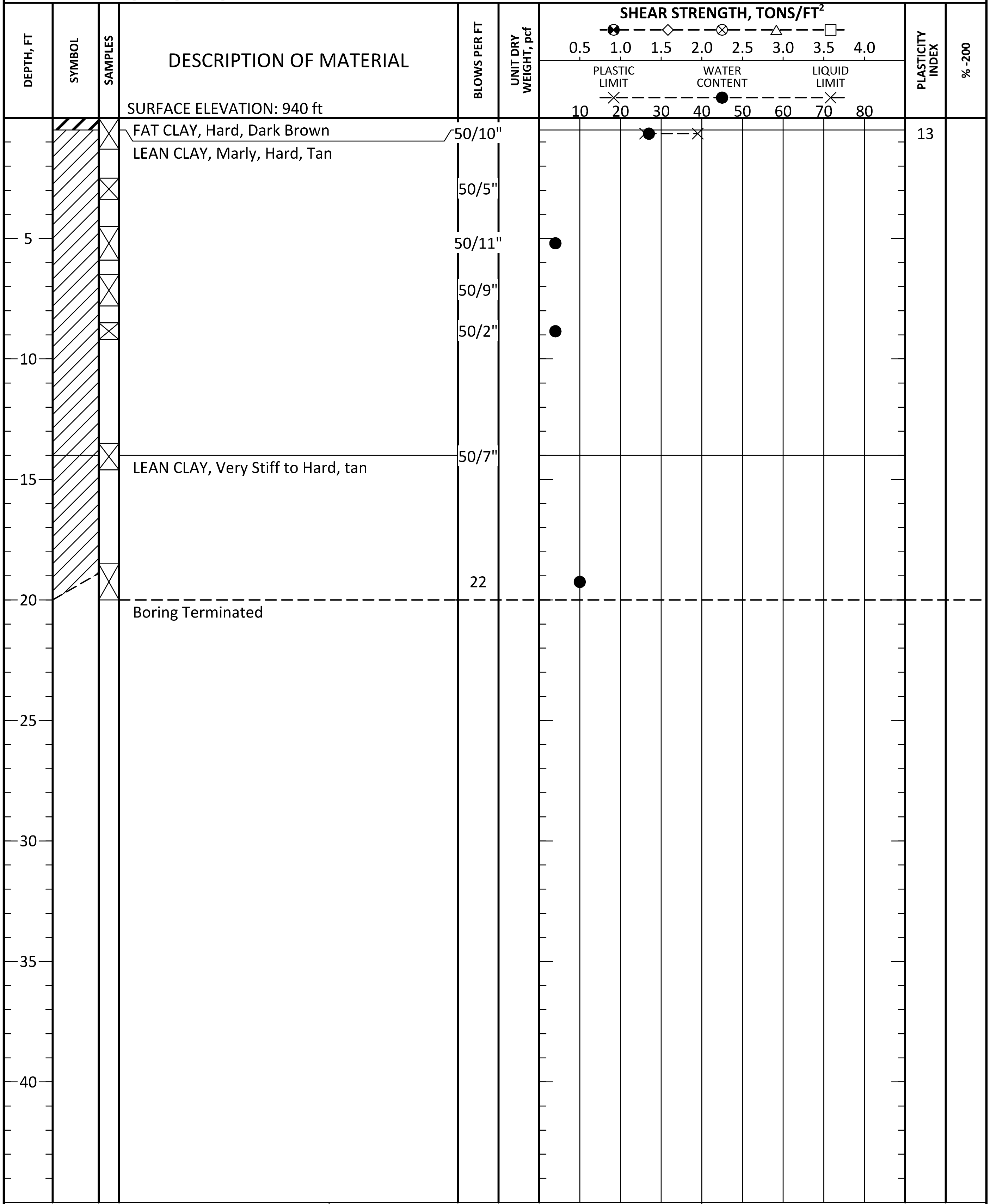
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46201; W 98.71230

SURFACE ELEVATION: 940 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
FAT CLAY, Hard, Dark Brown	50/10"	13
LEAN CLAY, Marly, Hard, Tan		
	50/5"	
	50/11"	
	50/9"	
	50/2"	
	50/7"	
LEAN CLAY, Very Stiff to Hard, tan		
	22	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 5/25/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/25/2022

PROJ. No.: ASA21-058-02
FIGURE: 42

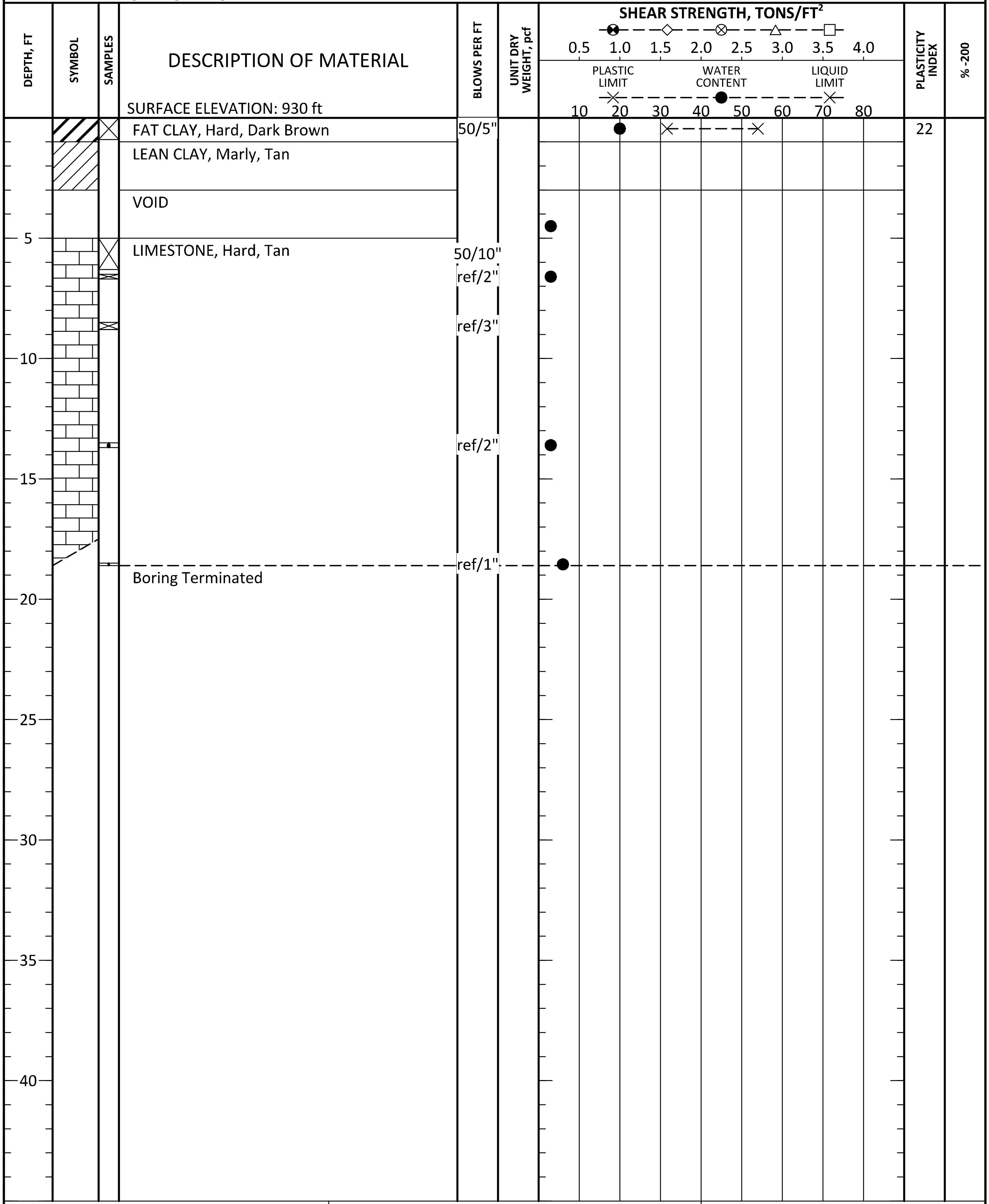
LOG OF BORING NO. RW-7

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46251; W 98.71334



SURFACE ELEVATION: 930 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
FAT CLAY, Hard, Dark Brown	50/5"		22	
LEAN CLAY, Marly, Tan				
VOID				
LIMESTONE, Hard, Tan	50/10" ref/2" ref/3" ref/2" ref/1"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	18.6 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/5/2022	**DATE MEASURED:**	5/5/2022	**FIGURE:**	43

LOG OF BORING NO. RW-8

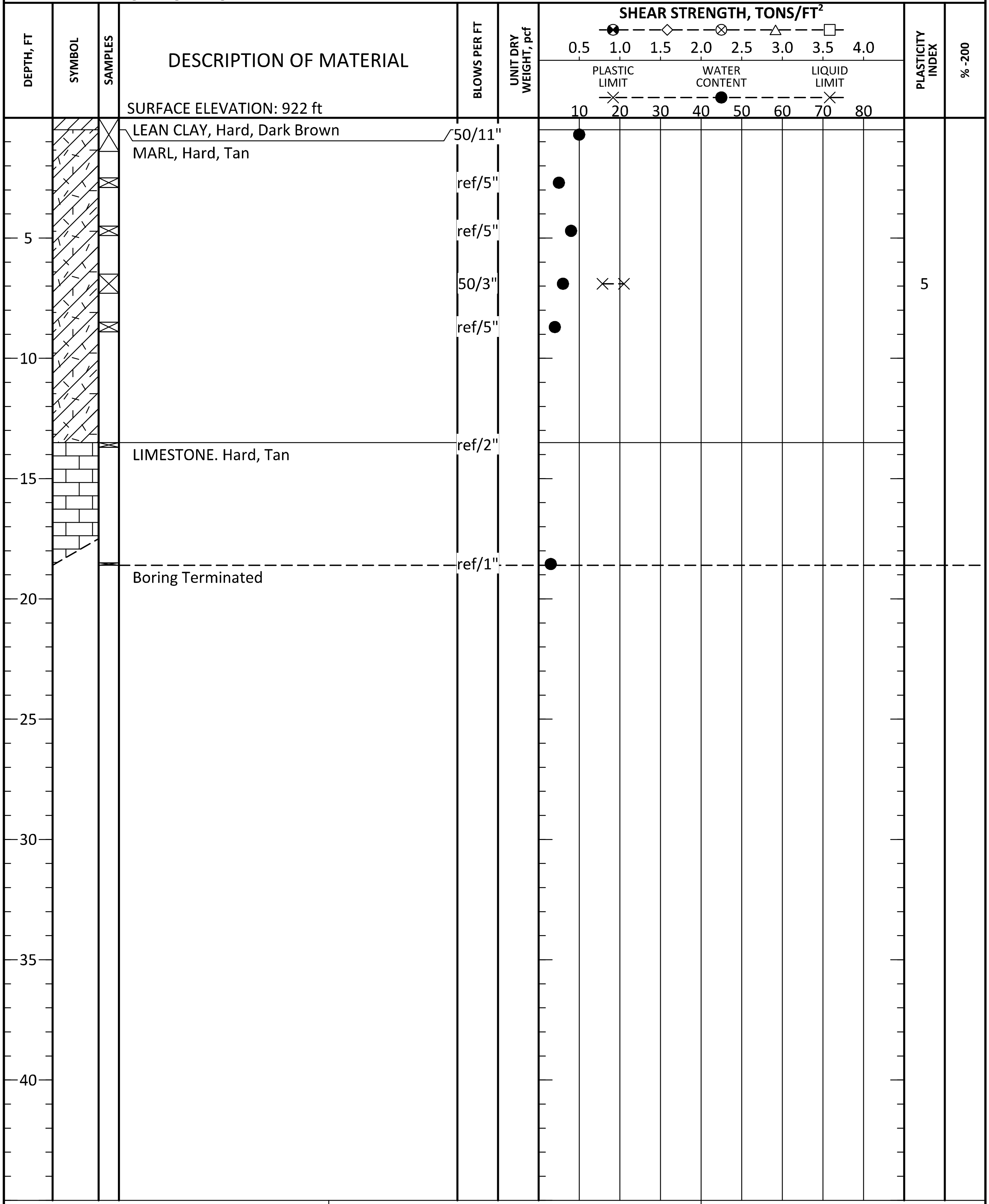
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46221; W 98.71377

SURFACE ELEVATION: 922 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
LEAN CLAY, Hard, Dark Brown	50/11"	
MARL, Hard, Tan	ref/5"	
	ref/5"	
	50/3"	5
	ref/5"	
LIMESTONE. Hard, Tan	ref/2"	
	ref/1"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	18.6 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASA21-058-02
DATE DRILLED:	5/5/2022	**DATE MEASURED:**	5/5/2022	**FIGURE:**	44

LOG OF BORING NO. SR-1

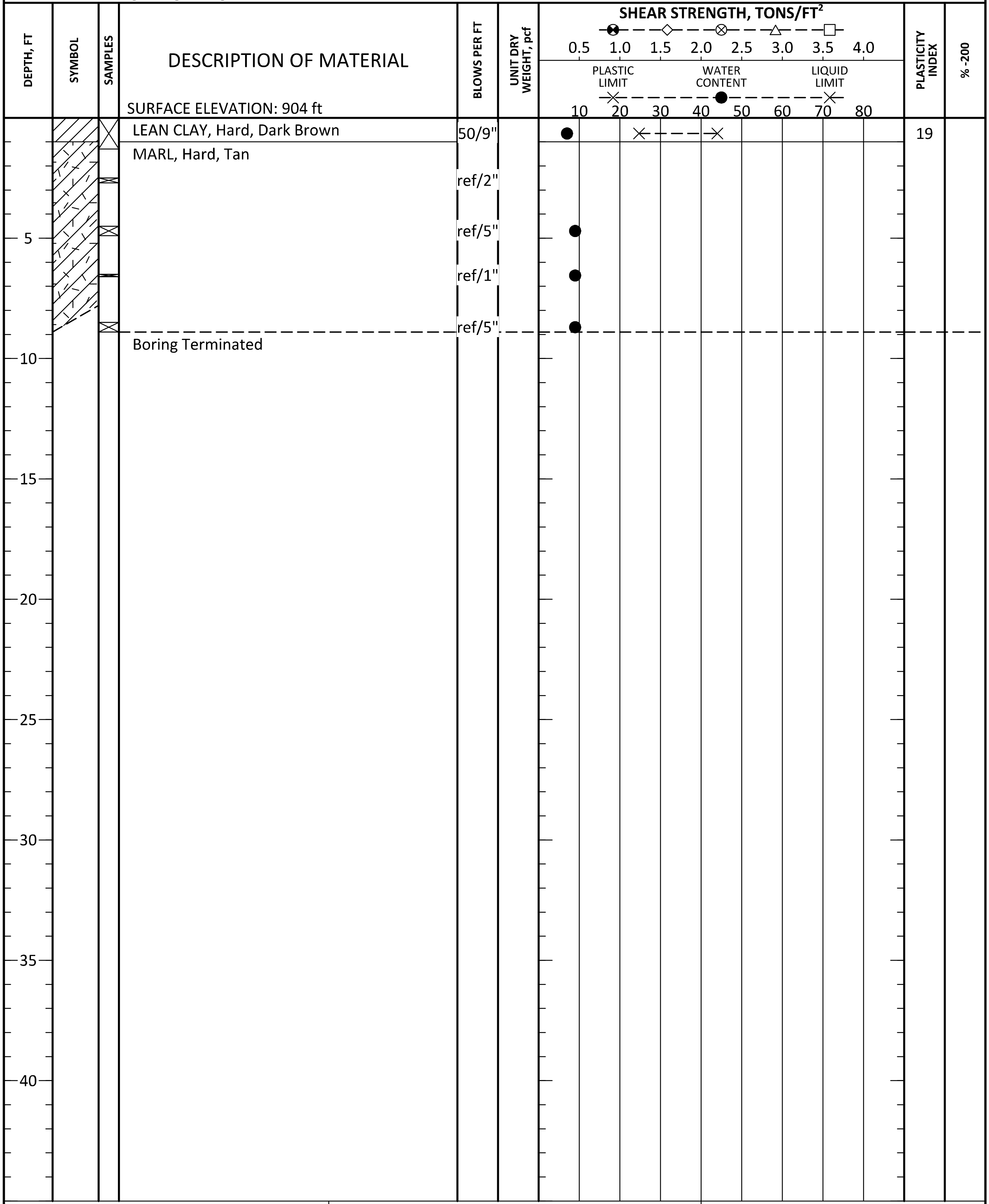
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.45924; W 98.71691

SURFACE ELEVATION: 904 ft



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
0	LEAN CLAY, Hard, Dark Brown	50/9"		19	
1	MARL, Hard, Tan				
2.5		ref/2"			
5		ref/5"			
6.5		ref/1"			
8.5		ref/5"			
8.9	Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.9 ft
DATE DRILLED: 5/23/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022

PROJ. No.: ASA21-058-02
FIGURE: 45

LOG OF BORING NO. SR-2

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

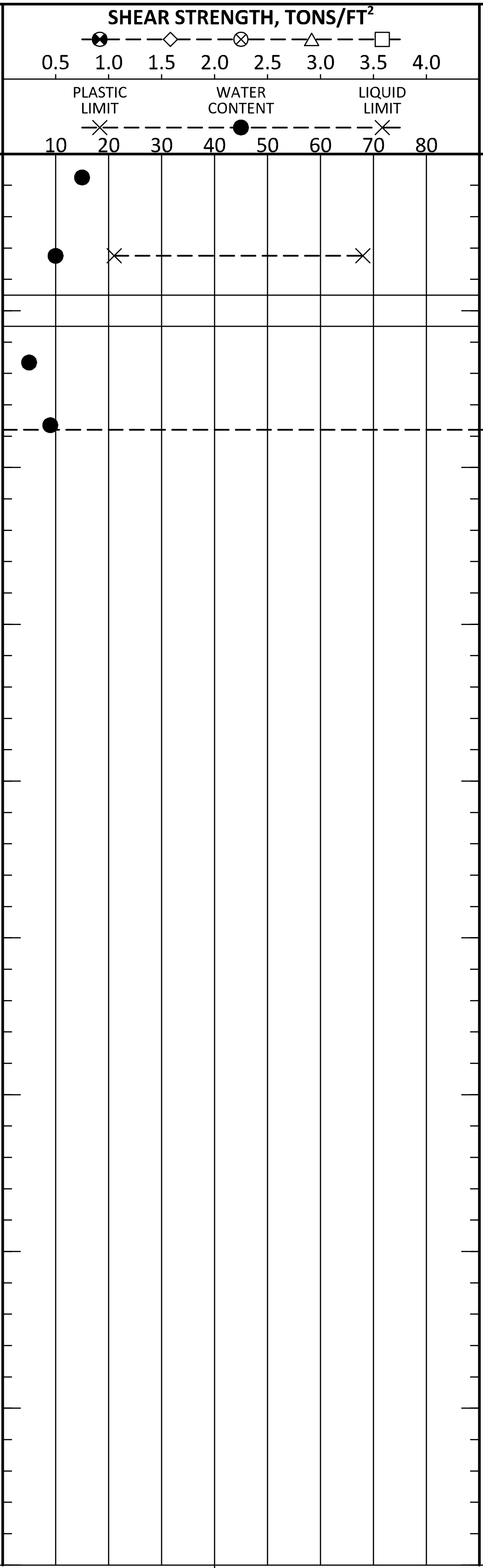
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46042; W 98.71674

SURFACE ELEVATION: 898 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	FAT CLAY, Very Stiff, Dark Brown	22			
		25		47	
5	LEAN CLAY, Hard, Reddish Brown to Tan	50/11"			
	MARL, Hard, Tan	ref/3"			
		ref/3"			
	Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.8 ft
DATE DRILLED: 5/23/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022

PROJ. No.: ASA21-058-02
FIGURE: 46

LOG OF BORING NO. SR-3

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

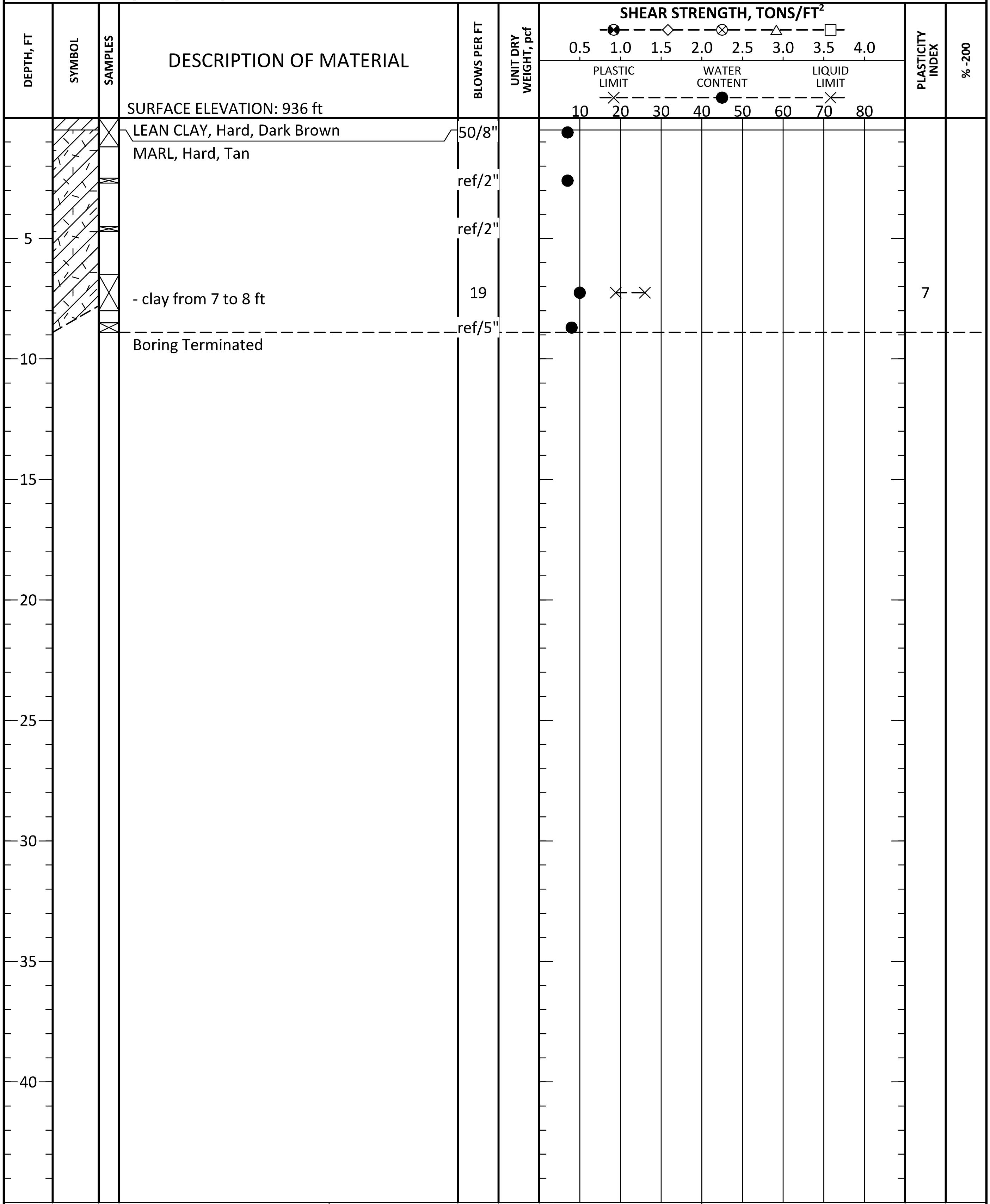
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46208; W 98.71725

SURFACE ELEVATION: 936 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
LEAN CLAY, Hard, Dark Brown	50/8"			
MARL, Hard, Tan				
	ref/2"			
	ref/2"			
- clay from 7 to 8 ft	19		7	
	ref/5"			
Boring Terminated				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.9 ft
DATE DRILLED: 5/23/2022

DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022

PROJ. No.: ASA21-058-02
FIGURE: 47

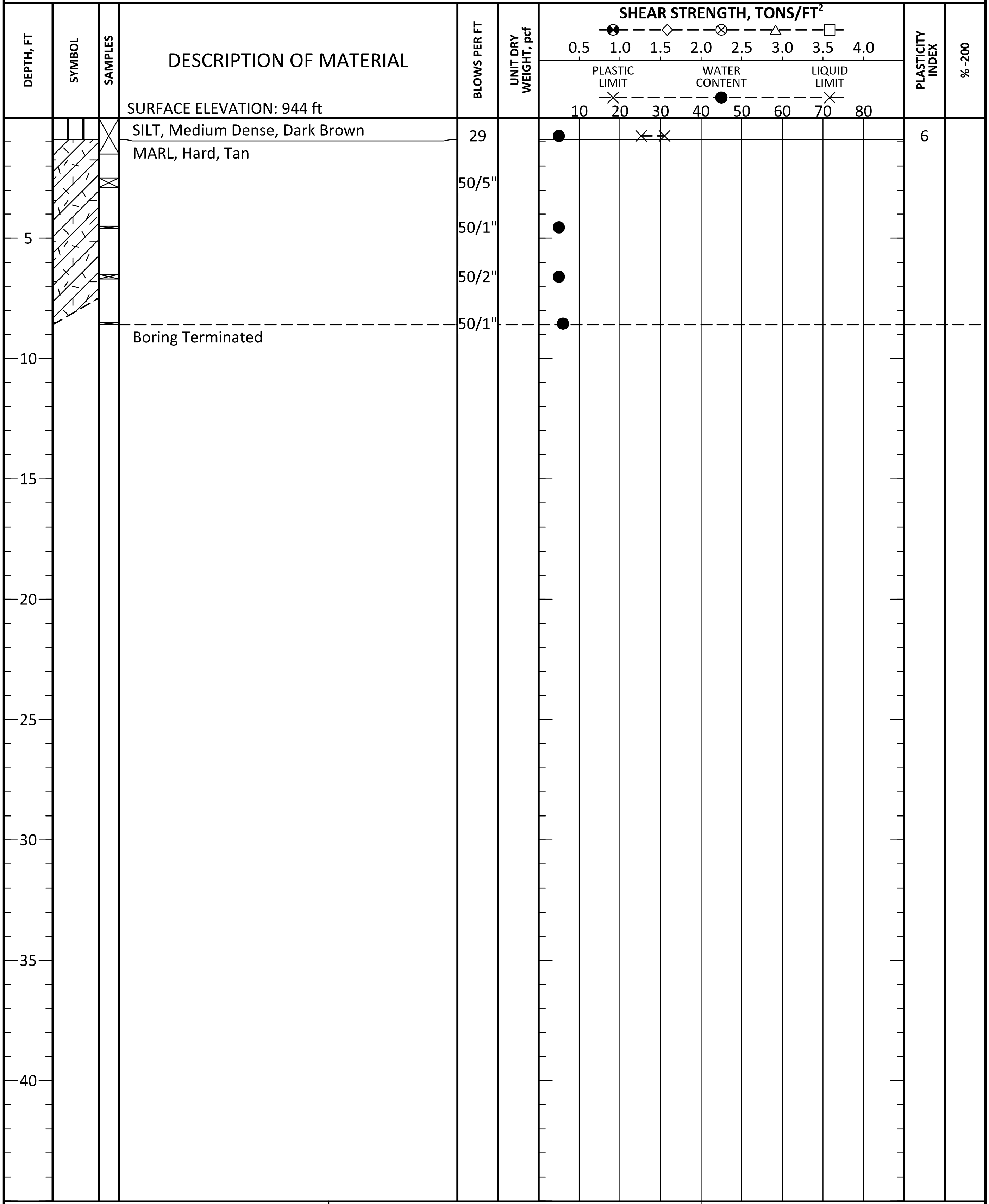
LOG OF BORING NO. SR-4

Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46299; W 98.71690



SURFACE ELEVATION: 944 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	PLASTICITY INDEX
SILT, Medium Dense, Dark Brown	29	6
MARL, Hard, Tan		
	50/5"	
	50/1"	
	50/2"	
	50/1"	
Boring Terminated		

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 8.6 ft
DATE DRILLED: 5/23/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022
PROJ. No.: ASA21-058-02
FIGURE: 48

LOG OF BORING NO. SR-5

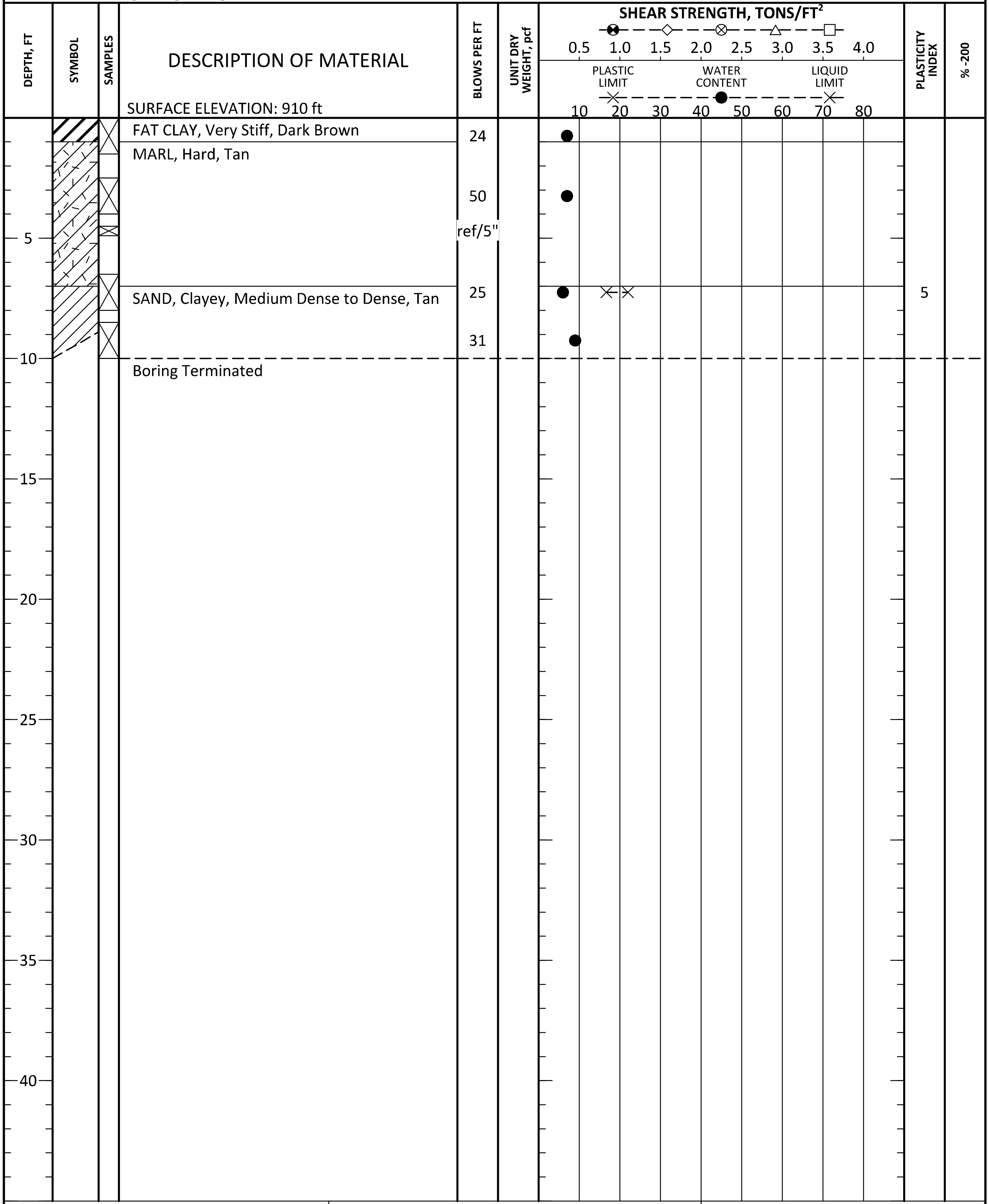
Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.46528; W 98.71607

SURFACE ELEVATION: 910 ft



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
FAT CLAY, Very Stiff, Dark Brown	24			
MARL, Hard, Tan	50			
	ref/5"			
SAND, Clayey, Medium Dense to Dense, Tan	25		5	
	31			
Boring Terminated				

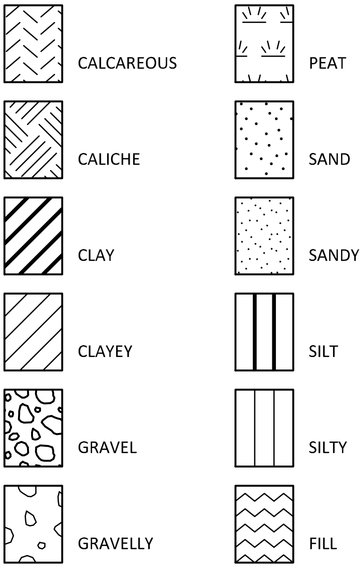
NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 10.0 ft
DATE DRILLED: 5/23/2022
DEPTH TO WATER: Dry
DATE MEASURED: 5/23/2022
PROJ. No.: ASA21-058-02
FIGURE: 49

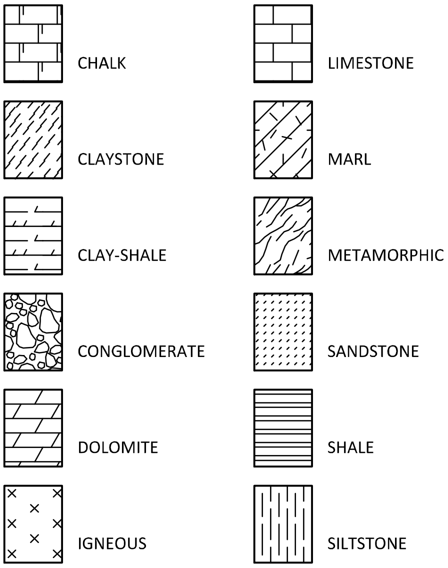
KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

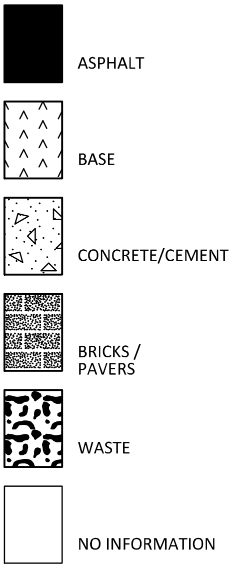
SOIL TERMS



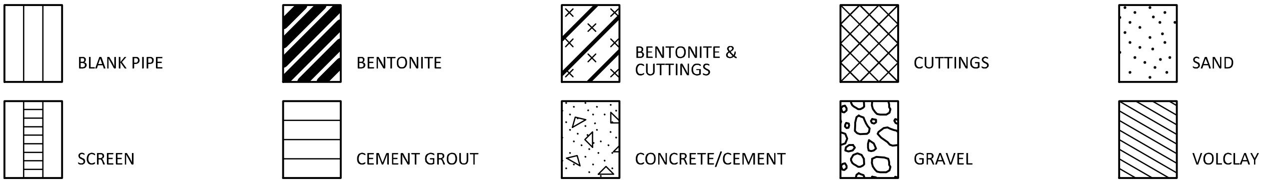
ROCK TERMS



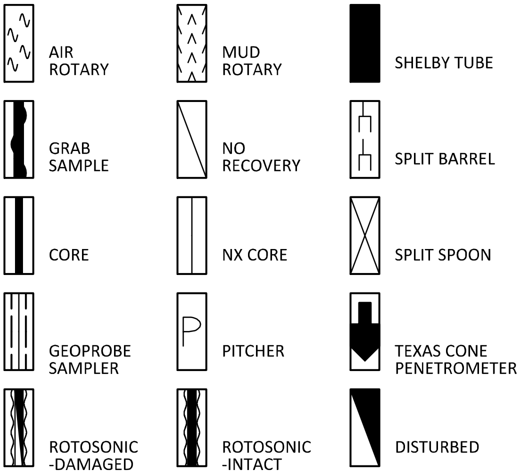
OTHER



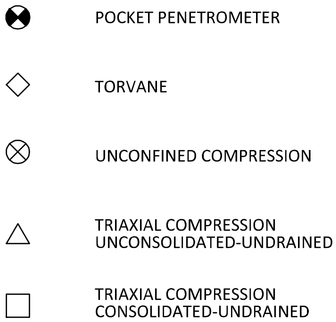
WELL CONSTRUCTION AND PLUGGING MATERIALS



SAMPLE TYPES



STRENGTH TEST TYPES



NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ASA21-058-02

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
El = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

PROJECT NO. ASA21-058-02

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

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

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

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

SPLIT-BARREL SAMPLER DRIVING RECORD

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

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

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-1	3.0 to 3.3	100/2"	8								
	8.0 to 8.1	100/0"	8								
	13.0 to 13.1	100/0"	10								
H-2	0.0 to 1.2	50/8"	5	31	23	8					
	2.5 to 2.6	ref/1"									
	4.5 to 4.9	ref/5"	11								
	6.5 to 6.8	ref/4'									
	8.5 to 8.7	ref/2"	13								
	15.0 to 15.9	50/5"									
	20.0 to 20.3	ref/3"	17								
	25.0 to 25.1	ref/1"									
	30.0 to 30.2	ref/2'	16								
	35.0 to 35.4	ref/5"									
	40.0 to 40.1	ref/1"									
H-3	0.0 to 0.8	50/4"	5								
	0.5 to 2.5	ref/6"									
	2.5 to 3.1	50/1"	8								
	4.5 to 5.3	50/4"									
	6.0 to 8.0										
	6.5 to 6.9	ref/5"	11								
	8.5 to 8.8	ref/3"	13								
	13.5 to 13.7	ref/2"	11								
	18.5 to 19.0	ref/6"	17	23	17	6					
	23.5 to 24.0	ref/6"									
	28.5 to 29.0	ref/6"	18								
	33.5 to 33.9	ref/5"	16								
	38.5 to 38.7	ref/2"									
H-4	0.0 to 1.5	50/5"	4								
	2.5 to 2.8	ref/3"									
	4.5 to 4.7	ref/2"	9								
	6.5 to 6.7	ref/2"									
	8.5 to 8.7	ref/2"	10								
	13.5 to 13.8	ref/4"									
	18.5 to 19.0	ref/6"	12	23	15	8					
	23.5 to 25.0	43	17	24	19	5					
	28.5 to 28.9	ref/5"									
	33.5 to 33.8	ref/3	14								
	38.5 to 38.7	ref/2"	12								
H-5	0.0 to 1.0		9	47	31	16					

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-5	3.0 to 3.5	100/4"									
	3.5 to 5.0										
	4.0		6								
	8.0 to 8.4	100/5"									
	8.4 to 10.0										
	10.0		10								
	13.0 to 13.1	100/1"									
	13.1 to 15.0										
	18.0 to 18.1	100/0.5"	12								
	18.1 to 20.0										
	23.0 to 23.1	100/0"									
	23.1 to 25.0										
	28.0 to 28.1	100/0"	13								
	28.1 to 30.0										
	33.0 to 33.1	100/0"									
	33.1 to 35.0										
	38.0 to 38.1	100/0"	12								
	38.1 to 40.0										
	43.0 to 43.1	100/0.5"									
	43.1 to 45.0										
	48.0 to 48.2	100/1.5"	16								
	48.2 to 50.0										
	53.0 to 53.2	100/1.5"									
	53.2 to 55.0										
H-6	0.0 to 1.5	10	10	30	24	6					
	2.5 to 2.8	ref/4"									
	4.5 to 4.7	ref/2"	9								
	6.5 to 6.8	ref/3"									
	8.5 to 9.6	50/7"	8								
	13.5 to 14.2	50/2"									
	18.5 to 18.8	ref/3"	11								
	23.5 to 23.7	ref/2"									
	28.5 to 28.8	ref/3"	13								
	33.5 to 33.6	ref/1"									
	38.5 to 38.6	ref/1"	18								
H-7	0.0 to 1.5	50	15								
	2.5 to 2.6	ref/2"									
	4.5 to 4.7	ref/2"	7								
	6.5 to 6.7	ref/2"									

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-7	8.5 to 9.4	50/5"	19	36	19	17					
	15.0 to 15.1	ref/1"									
	20.0 to 20.3	ref/3"	17								
	25.0 to 25.2	ref/2"									
	30.0 to 30.2	ref/2"	14								
	35.0 to 35.2	ref/2"									
	40.0 to 40.2	ref/2"	20								
H-8	3.0 to 3.1	100/0"	5								
	3.1 to 5.0										
	8.0 to 8.2	100/1"	5	19	16	3					
	8.2 to 10.0										
	13.0 to 13.1	100/0"									
	13.1 to 15.0										
	18.0 to 18.1	100/0"	10								
	18.1 to 20.0										
	23.0 to 23.1	100/0"									
	23.1 to 25.0										
	28.0 to 28.1	100/0"	15								
	28.1 to 30.0										
	33.0 to 33.1	100/1"									
	33.1 to 35.0										
	38.0 to 38.1	100/1"	13								
	38.1 to 40.0										
	43.0 to 43.1	100/0"									
	48.0 to 48.1	100/0"	12								
	48.1 to 50.0										
	53.0 to 53.3	100/3"									
	53.3 to 55.0										
H-9	0.0 to 0.8	ref/4"	10	57	33	24					
	2.5 to 3.1	ref/2"									
	4.5 to 5.3	ref/1"	4								
	6.5 to 8.0	ref/2"									
	8.5 to 8.8	ref/2"	10								
	15.0 to 15.1	ref/2"									
	20.0 to 20.2	ref/2"	11								
	25.0 to 25.3	ref/1"									
	30.0 to 30.1	ref/2"	11								
	35.0 to 35.1	ref/1"									
	40.0 to 40.1	ref/2"	13								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-9	45.0 to 45.2	ref/2"									
	50.0 to 50.1	ref/2"	13								
	55.0 to 55.1	ref/1"									
H-10	0.0 to 1.0		9	47	25	22					
	3.0 to 3.2	100/0									
	3.2 to 5.0										
	8.0 to 8.3	100/1"	6								
	8.3 to 10.0										
	13.0 to 13.1	100/0"									
	13.1 to 15.0										
	18.0 to 18.3	100/0"	12								
	18.3 to 20.0										
	23.0 to 23.2	100/0"									
	23.2 to 25.0										
	28.0 to 28.1	100/0.5"	14								
	28.1 to 30.0										
	33.0 to 33.1	100/1.5"									
	33.1 to 35.0										
	38.0 to 38.1	100/0.5"	13								
	38.1 to 40.0										
	43.0 to 43.1	100/0"									
	43.1 to 45.0										
	48.0 to 48.1	100/0"	12								
	48.1 to 50.0										
	53.0 to 53.1	100/0"									
	53.1 to 55.0										
H-11	0.0 to 1.5	47	6								
	2.5 to 4.0	35									
	4.5 to 6.0	41	8	29	21	8					
	6.5 to 7.8	50/9"									
	8.5 to 8.7	ref/2"	8								
	13.5 to 13.7	ref/2"	7								
	20.0 to 20.2	ref/2"									
	25.0 to 25.1	ref/1"									
	30.0 to 30.2	ref/2"	16								
	35.0 to 35.3	ref/3"									
	40.0 to 40.5	ref/6"	18								
	45.0 to 45.9	50/5"	20								
	50.0 to 50.1	ref/1"									

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-11	55.0 to 55.2	ref/2"									
H-12	0.0 to 1.5	36	7								
	2.5 to 3.1	ref/2"									
	4.5 to 5.3	ref/2"	8								
	6.5 to 8.0	ref/2"									
	8.5 to 8.8	ref/1"	9								
	15.0 to 15.1	ref/1"									
	20.0 to 20.2	ref/2"	11								
	25.0 to 25.3	ref/3"									
	30.0 to 30.1	ref/1"	11								
	35.0 to 35.1	ref/1"									
	40.0 to 40.1	ref/1"	14								
	45.0 to 45.2	ref/2"	15	23	16	7					
	50.0 to 50.1	ref/1"									
	55.0 to 55.1	ref/1"	9								
H-13	0.0 to 1.0		12	62	32	30					
	3.0 to 3.1	100/1"									
	3.1 to 5.0										
	8.0 to 8.1	100/1"	2								
	8.1 to 10.0										
	13.0 to 13.1	100/1"									
	13.1 to 15.0										
	18.0 to 18.1	100/1"	3								
	18.1 to 20.0										
	23.0 to 23.1	100/1"									
	23.1 to 25.0										
	28.0 to 28.1	100/1"	6								
	28.1 to 30.0										
	33.0 to 33.1	100/1"									
	33.1 to 35.0										
	38.0 to 38.1	100/1"	6								
	38.1 to 40.0										
	43.0 to 43.1	100/1"									
	43.1 to 45.0										
	48.0 to 48.1	100/1"									
	48.1 to 50.0										
	53.0 to 53.1	100/1"	8								
	53.1 to 55.0										
H-14	0.0 to 1.5	50/10"		45	26	19					

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-14	2.5 to 2.6	ref/1"									
	4.5 to 4.6	ref/1"									
	6.5 to 6.7	ref/2"									
	8.5 to 8.6	ref/0"									
	13.5 to 13.6	ref/1"									
	18.5 to 18.8	ref/1"									
	23.5 to 23.8	ref/3"									
	28.5 to 28.8	ref/3"									
	33.5 to 33.6	ref/1"									
	38.5 to 38.6	ref/1"									
H-15	0.0 to 1.0		11	48	22	26					
	3.0 to 3.4	100/3"									
	3.4 to 5.0										
	8.0 to 8.3	100/1.5"	8								
	8.3 to 10.0										
	13.0 to 13.1	100/1"									
	13.1 to 15.0										
	18.0 to 18.1	100/1"	6								
	18.1 to 20.0										
	23.0 to 23.1	100/1"									
	23.1 to 25.0										
	28.0 to 28.1	100/1"	13								
	28.1 to 30.0										
	33.0 to 33.1	100/1"									
	33.1 to 35.0										
	38.0 to 38.1	100/1"	12								
	38.1 to 40.0										
	43.0 to 43.1	100/1"									
	43.1 to 45.0										
	48.0 to 48.1	100/1"	11								
	48.1 to 50.0										
	53.0 to 53.1	100/1"									
	53.1 to 55.0										
H-16	0.0 to 1.5	10	3								
	2.5 to 2.8	ref/4"									
	4.5 to 4.7	ref/2"	3								
	6.5 to 6.8	ref/3"									
	8.5 to 9.1	50/7"	6	24	18	6					
	13.5 to 13.7	ref/2"									

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
H-16	18.5 to 18.8	ref/3"	9								
	23.5 to 23.7	ref/2"									
	28.5 to 28.8	ref/3"									
	33.5 to 33.6	ref/1"									
	38.5 to 38.6	ref/1"									
MB1-1	0.0 to 0.5		6								
	3.0 to 3.2	100/1"									
	3.2 to 5.0										
	8.0 to 8.3	100/2.5"	5								
	8.3 to 10.0										
	13.0 to 13.1	100/0.5"									
	13.1 to 15.0										
	18.0 to 18.3	100/2"	7								
	18.3 to 20.0										
	23.0 to 23.2	100/1.5"									
	23.2 to 25.0										
	28.0 to 28.1	100/0"	5								
	28.1 to 30.0										
	33.0 to 33.1	100/0"									
	33.1 to 35.0										
MB1-2	5.0 to 6.4	81/11"	3	20	17	3					
	9.0		2								
	10.0 to 10.1	100/0.5"									
	10.1 to 12.0										
	14.0		2								
	15.0 to 15.1	100/0.5"									
	15.1 to 17.0										
	19.0		6								
	20.0 to 20.4	100/2.5"									
	20.4 to 22.0										
	25.0 to 25.3	100/2"									
	25.3 to 27.0										
	30.0 to 30.3	100/2"									
	30.3 to 32.0										
	34.0 to 35.0										
	35.0 to 35.2	100/1"									
MB1-3	0.0 to 0.9	50/5"									
	2.5 to 2.7	50/2"									
	4.5 to 4.8	50/4"									

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
MB1-3	6.5 to 7.3	50/4"									
	8.5 to 8.7	ref/2"									
	15.0 to 15.2	50/2"									
	20.0 to 20.2	50/2"									
	25.0 to 25.3	50/3"									
	30.0 to 30.2	50/2"									
	35.0 to 35.1	ref/1"									
MB1-4	0.0 to 1.5	42	9								
	2.5 to 2.8	rerf/5"	4	NP	NP	NP					
	4.5 to 4.7	ref/5"	5								
	6.5 to 6.8	ref/5"									
	8.5 to 10.0	ref/2"	4								
	13.5 to 15.0	ref/3"									
	18.0		5								
	20.0 to 21.5	100/9"									
	23.0 to 23.5										
	25.0 to 26.5	89/10"									
	28.0 to 28.5		8								
	30.0 to 31.5	100/6"									
	33.0 to 33.5		9								
	35.0 to 35.6	100/5"									
MB1-5	0.0 to 0.1	ref/1"									
	0.1 to 0.5		5								
	2.5 to 2.8	50/11"	3								
	4.5 to 4.7	ref/1"									
	6.5 to 6.8	ref/2"	2	17	15	2					
	8.5 to 10.0	ref/1"									
	13.5 to 15.0	ref/5"	2								
	19.5 to 20.0										
	20.0 to 20.6	100/4"									
	24.5 to 25.0		7								
	25.0 to 25.5	100/3"									
	29.5 to 30.0										
	30.0 to 30.3	100/2"									
	34.5 to 35.0		8								
	35.0 to 36.0	100/8"									
MB2-1	5.0 to 5.3	100/2"	7	20	17	3					
	5.3 to 6.0										
	10.0 to 10.3	100/2"									

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
MB2-1	10.3 to 11.0										
	15.0 to 15.3	100/2"	6								
	15.3 to 16.0										
	20.0 to 20.2	100/1"									
	20.2 to 21.0										
	25.0 to 25.1	100/1"	3								
	25.1 to 26.0										
	30.0 to 30.2	100/1"									
	30.1 to 31.0										
	34.0 to 35.0		4								
	35.0 to 35.2	100/1"									
MB2-2	0.0 to 1.5	26									
	2.5 to 3.8	50/9"									
	4.8 to 5.7	50/5"									
	6.5 to 7.1	50/1"									
	8.5 to 8.7	ref/2"									
	13.5 to 13.8	ref/3"									
	18.5 to 18.9	ref/5"									
	23.5 to 24.5	50/6"									
	28.5 to 29.4	50/5"									
	33.5 to 33.6	ref/1"									
MB2-3	0.0 to 0.8	50/3"	16								
	2.5 to 2.6	ref/1"									
	4.8 to 6.3	49	4	23	19	4					
	6.5 to 6.9	ref/5"									
	8.5 to 9.0	ref/6"	12								
	15.0 to 15.3	ref/3"									
	20.0 to 20.2	ref/2"	15								
	25.0 to 25.4	ref/5"									
	30.0 to 30.2	ref/2"	17								
	35.0 to 35.2	ref/2"	16								
MB2-4	5.0 to 5.8	100/8"	5								
	5.8 to 7.0										
	10.0 to 10.3	100/2"									
	10.3 to 12.0										
	15.0 to 16.1	100/10"	2	19	15	4					
	16.1 to 17.0										
	20.0 to 20.2	100/1"									
	20.2 to 22.0										

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
MB2-4	25.0 to 25.2	100/1"	5								
	25.2 to 27.0										
	30.0 to 30.1	100/1"									
	30.1 to 32.0										
	34.0		3								
	35.0 to 35.2	100/1"									
	35.2 to 37.0										
MB2-5	0.0 to 1.5	16	8								
	2.5 to 2.8	21	14								
	4.5 to 4.7	38									
	6.5 to 6.8	50/5"	12								
	8.5 to 10.0	50/11"	26	73	34	39					
	13.5 to 15.0	ref/3"									
	18.5 to 20.0	ref/1"	4								
	23.5 to 24.0										
	25.0 to 25.4	100/3"									
	28.0 to 28.5		8								
	30.0 to 31.3	80/11"									
	33.0 to 33.5		8								
	35.0 to 35.8	100/8"									
MB2-6	0.0 to 1.4	50/11"	12	45	34	11					
	2.5 to 2.7	ref/2"									
	4.5 to 4.9	ref5"	15								
	6.5 to 6.8	ref/4"									
	8.5 to 8.8	ref/4"	13								
	15.0 to 15.7	50/2'	24								
MB2-7	0.0 to 0.1	ref/1"									
	0.1 to 0.5		11								
	2.5 to 2.8	ref/2"									
	4.5 to 4.7	ref/3"	9	24	14	10					
	6.5 to 6.8	ref/2"									
	8.5 to 10.0	ref/3"	10								
	13.0 to 13.5										
	15.0 to 15.5	100/7"									
	18.0 to 18.5		13								
	20.0 to 20.3	100/7"									
	23.0 to 23.5										
	25.0 to 26.0	100/7"									
	28.0 to 28.5		8								

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
MB2-7	30.0 to 31.3	75									
	33.0 to 34.3		12								
	35.0 to 35.8	98/8"									
P-1	0.0 to 0.8	42	16	44	19	25					
	2.5 to 3.1	ref/4"	18								
	4.5 to 5.3	ref/5"	6								
	6.5 to 6.9	ref/1"	5								
	8.5 to 8.8	ref/4"	13								
P-2	0.0 to 1.5	10	21	71	24	47					
	2.5 to 3.3	50/3"									
	4.5 to 4.8	ref/4"	11								
	6.5 to 6.6	ref/1"	7								
	8.5 to 8.9	ref/5"	11								
P-3	0.0 to 1.3	50/10"	6								
	2.5 to 3.3	50/4"	11								
	4.5 to 5.6	50/7"	7	22	17	5					
	6.5 to 6.8	ref/3"									
	8.5 to 9.4	50/5"	10								
P-4	0.0 to 1.5	20	10								
	2.5 to 4.0	19	19	68	23	45					
	4.5 to 6.0	44									
	6.5 to 6.9	ref/5"	10								
	8.5 to 8.7	ref/2"	10								
P-5	0.0 to 0.6	50/1"	7	58	38	20					
	2.5 to 2.6	ref/1"									
	4.5 to 4.7	ref/2"	8								
	6.5 to 6.8	ref/4"	13								
	8.5 to 8.7	ref/2"	11								
P-6	0.0 to 1.5	40	15	33	24	9					
	2.5 to 4.0	50									
	4.5 to 5.0	50/6"	15	26	19	7					
	6.5 to 6.6	ref/1"									
	8.5 to 8.7	ref/2"	9								
P-7	0.0 to 1.2	50/8"									
	2.5 to 3.3	50/4"	3								
	4.5 to 4.6	ref/1"									
	6.5 to 6.7	ref/2"									
	8.5 to 9.4	50/5"									
RW-1	0.0 to 1.5	11	8								

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
RW-1	2.5 to 3.3	50/4"									
	4.5 to 5.5	50/6"	6								
	6.5 to 6.8	ref/4'									
	8.5 to 9.0	ref/6"	9	26	18	8					
	13.5 to 13.7	ref/2"									
	18.5 to 18.7	ref/2	7								
RW-2	0.0 to 1.5		21					102		2.69	UC
	2.5 to 4.0	17	16	70	22	48					
	4.5 to 4.6	ref/1"									
	6.5 to 6.8	ref/4"	5								
	8.5 to 8.8	ref/4									
	13.5 to 13.8	ref/4"	10								
	18.5 to 19.0	ref/5"	16								
RW-3	0.0 to 1.0		25	60	36	24					
RW-4	0.0 to 0.9	50/5"	4								
	2.5 to 3.7	50/8"									
	4.5 to 6.0	28	4								
	6.5 to 8.0	27	3	20	16	4					
	8.5 to 9.8	50/9"	3								
	13.5 to 14.7	50/8"									
	18.5 to 20.0	39	8								
RW-5	0.0 to 0.9	50/5"	8								
	2.5 to 2.9	ref/5"									
	4.5 to 4.8	ref/3"	7								
	6.5 to 6.7	ref/2"	7								
	8.5 to 9.8	50/10"	8								
	13.5 to 14.3	50/3"									
	18.5 to 19.0	45	16	19	14	5					
RW-6	0.0 to 1.3	50/10"	27	39	26	13					
	2.5 to 3.4	50/5"									
	4.5 to 5.9	50/11"	4								
	6.5 to 7.8	50/9"									
	8.5 to 9.2	50/2"	4								
	13.5 to 14.6	50/7"									
	18.5 to 20.0	22	10								
RW-7	0.0 to 0.9	50/5"	20	54	32	22					
	4.5		3								
	5.0 to 6.3	50/10"									
	6.5 to 6.7	ref/2"	3								

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Westover Hills Hospital
Loop 1604 and Wiseman Road
Bexar County, Texas

FILE NAME: ASA21-058-02.GPJ 6/2/2022

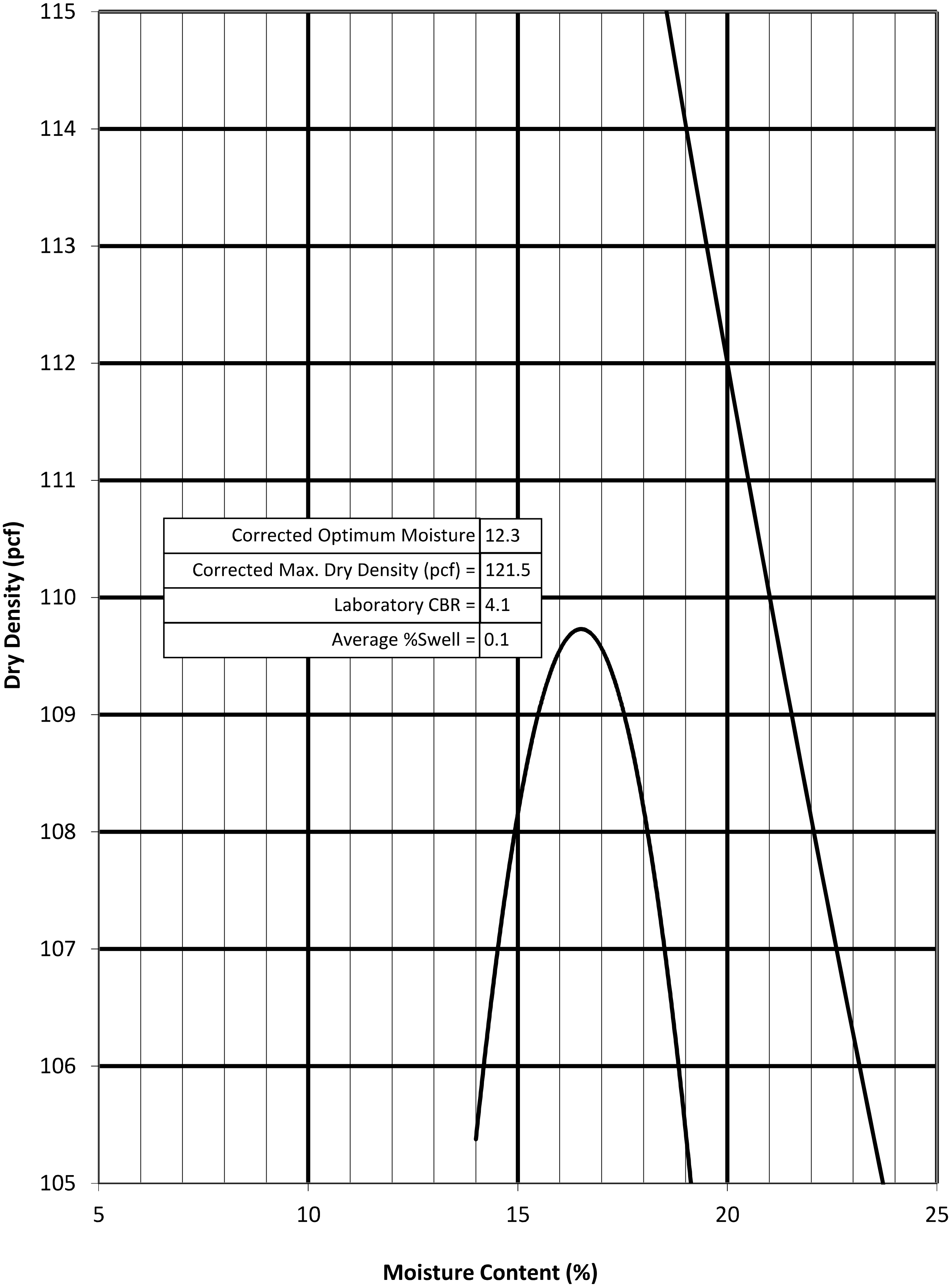
Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
RW-7	8.5 to 8.8	ref/3"									
	13.5 to 13.7	ref/2"	3								
	18.5 to 18.6	ref/1"	6								
RW-8	0.0 to 1.4	50/11"	10								
	2.5 to 2.9	ref/5"	5								
	4.5 to 4.9	ref/5"	8								
	6.5 to 7.3	50/3"	6	21	16	5					
	8.5 to 8.9	ref/5"	4								
	13.5 to 13.7	ref/2"									
	18.5 to 18.6	ref/1"	3								
SR-1	0.0 to 1.3	50/9"	7	44	25	19					
	2.5 to 2.7	ref/2"									
	4.5 to 4.9	ref/5"	9								
	6.5 to 6.6	ref/1"	9								
	8.5 to 8.9	ref/5"	9								
SR-2	0.0 to 1.5	22	15								
	2.5 to 4.0	25	10	68	21	47					
	4.5 to 5.9	50/11"									
	6.5 to 6.8	ref/3"	5								
	8.5 to 8.8	ref/3"	9								
SR-3	0.0 to 1.2	50/8"	7								
	2.5 to 2.7	ref/2"	7								
	4.5 to 4.7	ref/2"									
	6.5 to 8.0	19	10	26	19	7					
	8.5 to 8.9	ref/5"	8								
SR-4	0.0 to 1.5	29	5	31	25	6					
	2.5 to 2.9	50/5"									
	4.5 to 4.6	50/1"	5								
	6.5 to 6.7	50/2"	5								
	8.5 to 8.6	50/1"	6								
SR-5	0.0 to 1.5	24	7								
	2.5 to 4.0	50	7								
	4.5 to 4.9	ref/5"									
	6.5 to 8.0	25	6	22	17	5					
	8.5 to 10.0	31	9								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

MOISTURE DENSITY RELATIONSHIP CURVE (ASTM D698)

Westover Hills Hospital



Corrected Optimum Moisture	12.3
Corrected Max. Dry Density (pcf) =	121.5
Laboratory CBR =	4.1
Average %Swell =	0.1

Project Number: ASA21-058-02
Test Date: June 2, 2022

RABA KISTNER

DCP TEST DATA

SR-1
Westover Hills Hospital
Bexar County, Texas

Type of Ham.	No. of Blows	Penetration		CBR (%)	M_R (ksi)	q_{ult} (ksf)
		Incre. (mm)	Cumm. (in)			
1	2	30	1.2	14	21	3.15
1	2	20	2	22	33	4.25
1	2	80	5.1	5	7.5	1.59
1	2	30	6.3	14	21	3.15
1	3	30	7.5	22	33	4.25
1	3	30	8.7	22	33	4.25
1	3	30	9.8	22	33	4.25
1	3	20	10.6	35	52.5	5.79
1	3	40	12.2	16	24	3.44
1	3	50	14.2	13	19.5	3.00
1	3	55	16.3	11	16.5	2.69
1	3	5	16.5	165	247.5	16.21
1	3	20	17.3	35	52.5	5.79
1	3	10	17.7	76	114	9.69
1	1	1	17.8	292	438	23.69
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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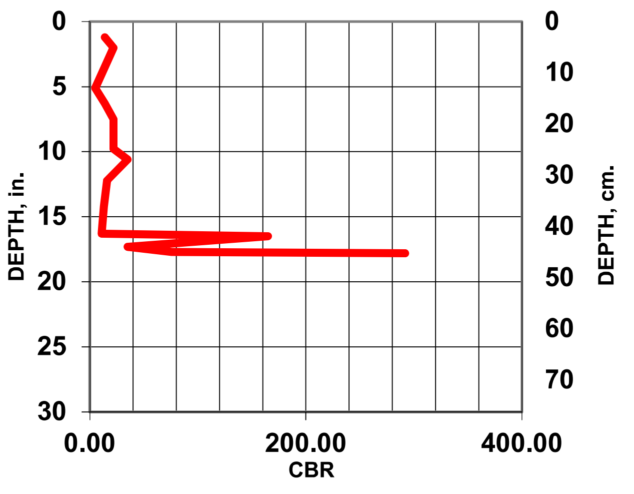
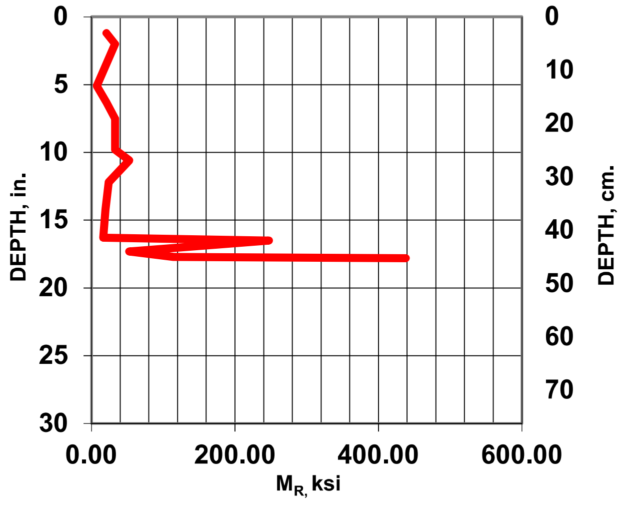
-	-	-	-	-	-	-
-	-	-	-	-	-	-

NOTES: Hammer 17.6 lbs = 1 Hammer 10.1 lbs = 2





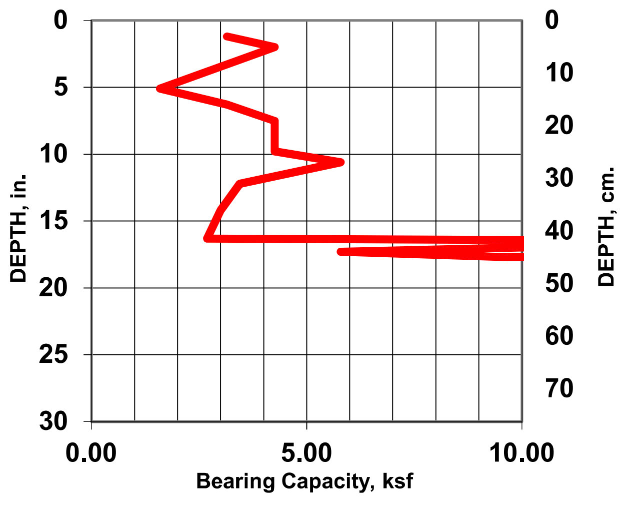


Figure 53a

Project Number: ASA21-058-02
Test Date: June 2, 2022

RABA KISTNER

DCP TEST DATA

SR-2

Westover Hills Hospital
Bexar County, Texas

Type of Ham.	No. of Blows	Penetration		CBR (%)	M_R (ksi)	q_{ult} (ksf)
		Incre. (mm)	Cumm. (in)			
1	1	30	1.2	6	9	1.80
1	1	20	2	10	15	2.52
1	1	20	2.8	10	15	2.52
1	1	20	3.5	10	15	2.52
1	3	40	5.1	16	24	3.44
1	3	40	6.7	16	24	3.44
1	3	40	8.3	16	24	3.44
1	3	40	9.8	16	24	3.44
1	3	40	11.4	16	24	3.44
1	3	30	12.6	22	33	4.25
1	3	35	14	19	28.5	3.86
1	3	35	15.4	19	28.5	3.86
1	3	40	16.9	16	24	3.44
1	3	30	18.1	22	33	4.25
1	3	30	19.3	22	33	4.25
1	3	30	20.5	22	33	4.25
1	3	10	20.9	76	114	9.69
1	3	10	21.3	76	114	9.69
1	3	10	21.7	76	114	9.69
1	2	30	22.8	14	21	3.15
1	2	20	23.6	22	33	4.25
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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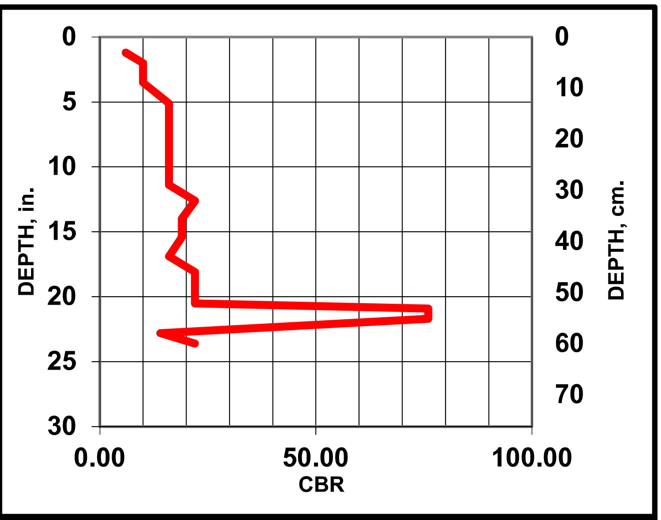
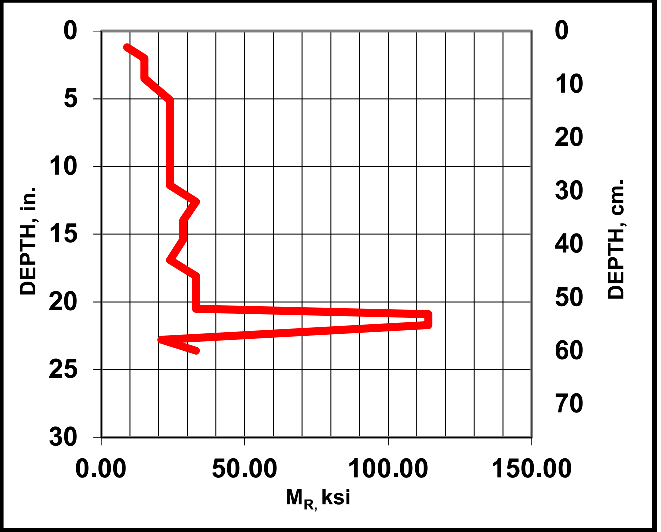
NOTES: Hammer 17.6 lbs = 1 Hammer 10.1 lbs = 2





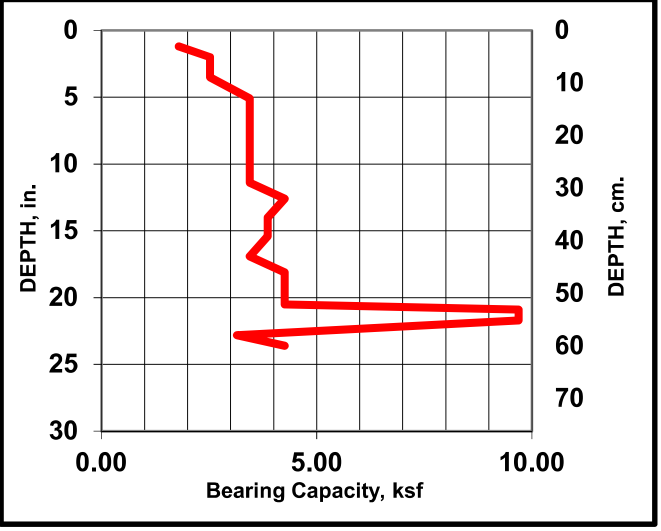


Figure 53b

Project Number: ASA21-058-02
Test Date: June 2, 2022

RABA KISTNER

DCP TEST DATA

SR-3

Westover Hills Hospital
Bexar County, Texas

Type of Ham.	No. of Blows	Penetration		CBR (%)	M_R (ksi)	q_{ult} (ksf)
		Incre. (mm)	Cumm. (in)			
1	1	40	1.6	5	7.5	1.59
1	1	40	3.1	5	7.5	1.59
1	1	30	4.3	6	9	1.80
1	1	30	5.5	6	9	1.80
1	1	5	5.7	48	72	7.14
1	1	15	6.3	14	21	3.15
1	1	20	7.1	10	15	2.52
1	1	15	7.7	14	21	3.15
1	1	5	7.9	48	72	7.14
1	2	10	8.3	48	72	7.14
1	2	20	9.1	22	33	4.25
1	2	10	9.4	48	72	7.14
1	2	50	11.4	8	12	2.17
1	2	30	12.6	14	21	3.15
1	1	20	13.4	10	15	2.52
1	1	20	14.2	10	15	2.52
1	2	1	14.2	635	952.5	39.67
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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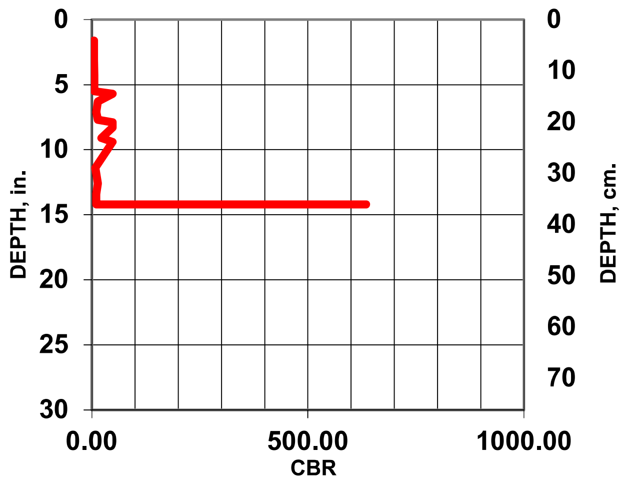
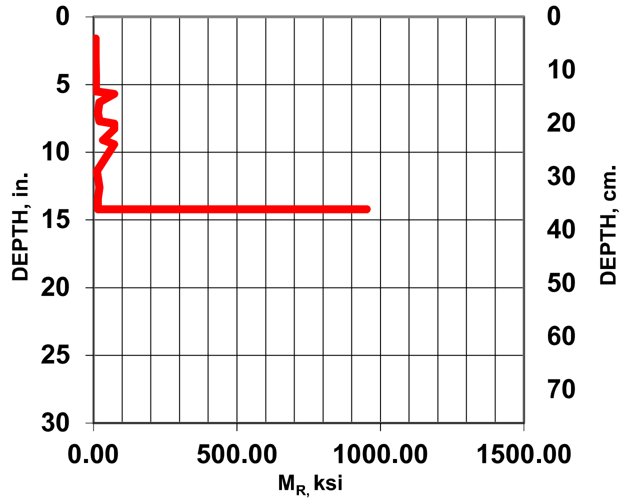
NOTES: Hammer 17.6 lbs = 1 Hammer 10.1 lbs = 2





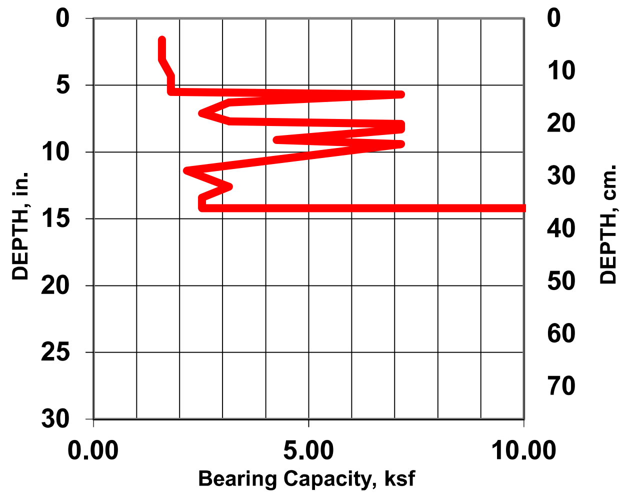


Figure 53c

Project Number: ASA21-058-02
Test Date: June 2, 2022

DCP TEST DATA

SR-4

Westover Hills Hospital
Bexar County, Texas

Type of Ham.	No. of Blows	Penetration		CBR (%)	M_R (ksi)	q_{ult} (ksf)
		Incre. (mm)	Cumm. (in)			
1	2	45	1.8	9	13.5	2.35
1	2	10	2.2	48	72	7.14
1	2	15	2.8	31	46.5	5.34
1	2	15	3.3	31	46.5	5.34
1	3	20	4.1	35	52.5	5.79
1	3	10	4.5	76	114	9.69
1	3	15	5.1	48	72	7.14
1	3	10	5.5	76	114	9.69
1	3	10	5.9	76	114	9.69
1	1	1	5.9	292	438	23.69
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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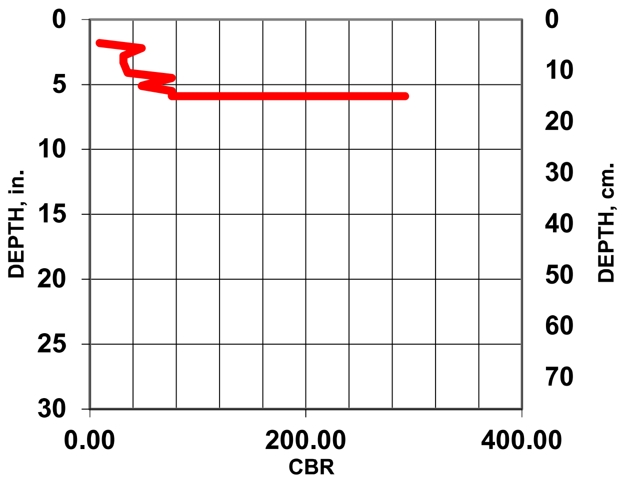
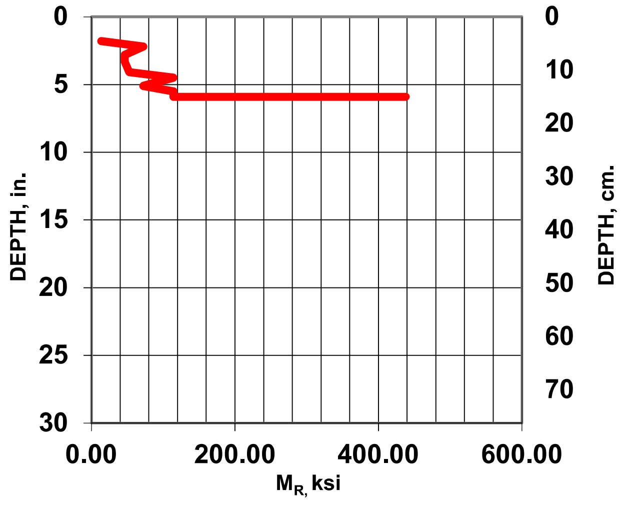
NOTES: Hammer 17.6 lbs = 1 Hammer 10.1 lbs = 2





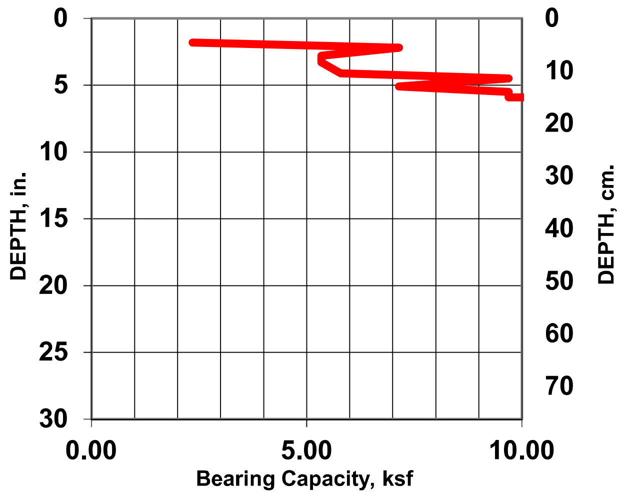


Figure 53d

Project Number: ASA21-058-02
Test Date: June 2, 2022

DCP TEST DATA

SR-5

Westover Hills Hospital
Bexar County, Texas

Type of Ham.	No. of Blows	Penetration Incre. (mm)	Penetration Cumm. (in)	CBR (%)	M_R (ksi)	q_{ult} (ksf)
1	2	40	1.6	10	15	2.52
1	2	30	2.8	14	21	3.15
1	2	40	4.3	10	15	2.52
1	2	40	5.9	10	15	2.52
1	1	20	6.7	10	15	2.52
1	1	30	7.9	6	9	1.80
1	1	25	8.9	8	12	2.17
1	1	25	9.8	8	12	2.17
1	1	30	11	6	9	1.80
1	1	30	12.2	6	9	1.80
1	1	30	13.4	6	9	1.80
1	1	30	14.6	6	9	1.80
1	1	10	15	22	33	4.25
1	1	30	16.1	6	9	1.80
1	1	10	16.5	22	33	4.25
1	1	1	16.6	292	438	23.69
-	-	-	-	-	-	-
-	-	-	-	-	-	-
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-	-	-	-	-	-	-
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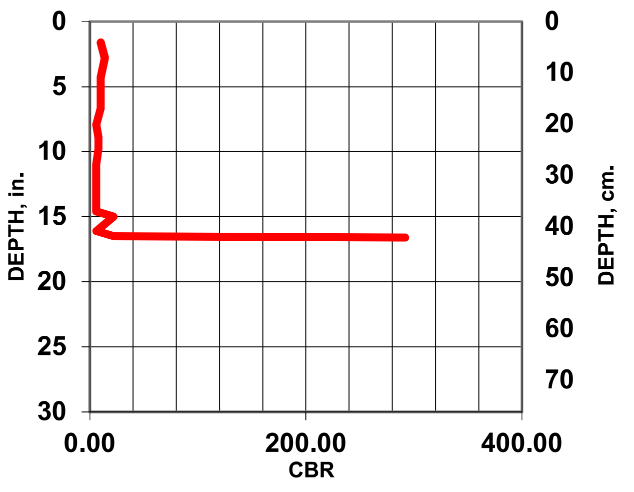
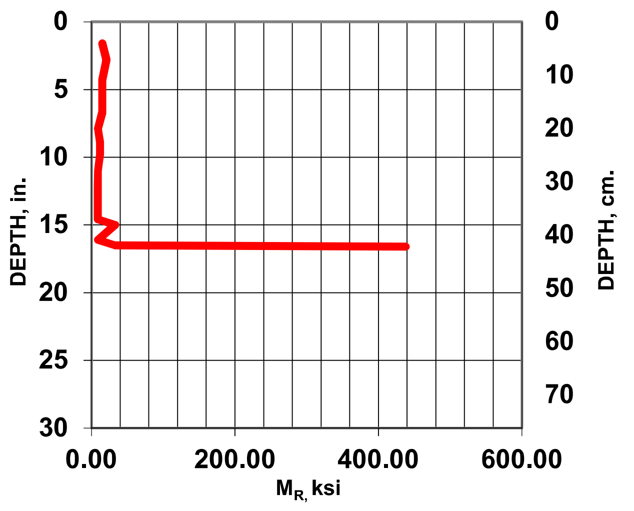
NOTES: Hammer 17.6 lbs = 1 Hammer 10.1 lbs = 2





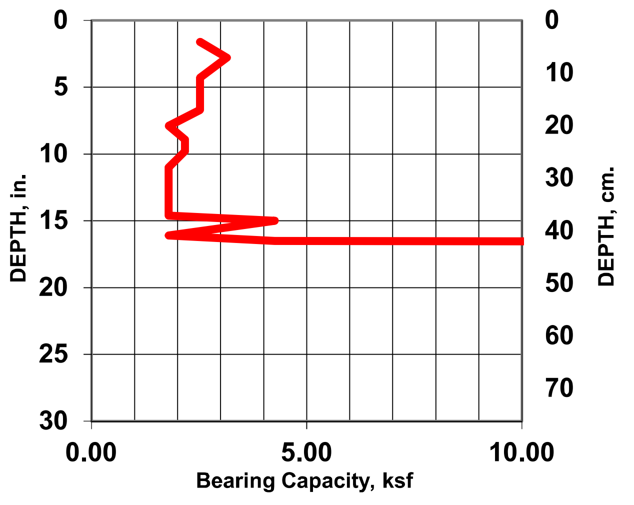


Figure 53e

Important Information about This

Geotechnical-Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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 constructor — 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 this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this 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.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many 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 a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the 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 geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this 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 geotechnical-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 confirmation-dependent recommendations included in your report. *Confirmation-dependent 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 confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront 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. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical 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 Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors 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 constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors 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 constructors fail to 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.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental 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 environmental 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, many 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 GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC
GEOTECHNICAL
BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
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e-mail: info@geoprofessional.org www.geoprofessional.org

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