GEOTECHNICAL ENGINEERING REPORT

STAYBRIDGE SUITES

1301 EAST LARK STREET

SPRINGFIELD, MISSOURI

Prepared for:

Siraff, Inc.
[redacted]
St. Robert, Missouri 65584

Prepared by:

- Geotechnical Services
- Environmental Services
- Material Testing Services

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PROJECT NUMBER: 23-2051

May 8, 2023

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May 8, 2023

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Attn: Mr. Bruce Farris
Email: Brucefarris@zlofthotel.com

RE: Geotechnical Engineering Report
Staybridge Suites
1301 East Lark Street
Springfield, Missouri
PPI Project Number: 23-2051

Dear Mr. Farris:

Attached, please find the report summarizing the results of the geotechnical investigation conducted for the proposed Staybridge Suites in Springfield, Missouri. We appreciate this opportunity to be of service and if you have any questions, please don't hesitate to contact this office.

PALMERTON & PARRISH, INC.
By:

Claire Lakin

Claire Lakin, E.I.
Geotechnical Engineer

PALMERTON & PARRISH, INC.
By:

STATE OF MISSOURI
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May 8, 2023

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EXECUTIVE SUMMARY

A Geotechnical Investigation was performed for the new Staybridge Suites located at 1301 East Lark Street in Springfield, Missouri. It is understood that the structure will be four (4) stories in height, utilize a slab-on-grade floor system, and measure 15,300 square feet in plan view. Finish Floor Elevation (FFE) for the first floor is anticipated to be ±1293.66 feet. Retaining walls are anticipated along the north side and along portions of the east and west sides of the site. Additionally, pavement for parking and drive lanes is anticipated. Foundation loadings are anticipated to be light to moderate, and floor slab loadings are anticipated to be light. Traffic loading was not provided but is assumed to be light. Fill depths ranging from 0.5 to 6.0 feet are anticipated to be required to provide finish subgrade elevations within the building footprint. Minimal to moderate depths of cut and/or fill are anticipated to be required to provide finish subgrade elevations outside of the building footprint. However, due to the fill depths anticipated at the proposed site, the grade of the parking area may be lowered along the northern, northwestern, and northeastern sides.

Based upon the information obtained from the borings drilled and subsequent laboratory testing, the site is suitable for the proposed building. Important geotechnical considerations for the project are summarized below. However, users of the information contained in the report must review the entire report for specific details pertinent to geotechnical design considerations.

- Moisture sensitive lean clays were noted near the surface of the subgrade exploration within all borings drilled to a depth ranging from 1 to 2 ft. below the existing ground surface. This material is generally stable in dry conditions but is sensitive to the addition of moisture and repeated traffic. Some over excavation and replacement or stabilization may be required of these soils;
- Fat (high plastic) clay with less than 30% gravel/sand was encountered across the subject site. Some fat clays with less than 30% gravel should be anticipated within

EXECUTIVE SUMMARY - CONTINUED

the influence of the proposed building. If encountered, this material should be remediated as described within Section 7 of this report;

- Foundations bearing on native soil and/or controlled fill for the new building can be designed for an allowable bearing capacity of 2,500 psf for column footings and 2,000 psf for continuous footings;
- The project site classifies as a Site Class D in accordance with Section 1613 of the 2018 International Building Code (IBC); and
- Palmerton & Parrish, Inc. should be retained for construction observation and construction materials testing. Close monitoring of subgrade preparation work is considered critical to achieve adequate pavement and subgrade performance.

GEOTECHNICAL ENGINEERING REPORT

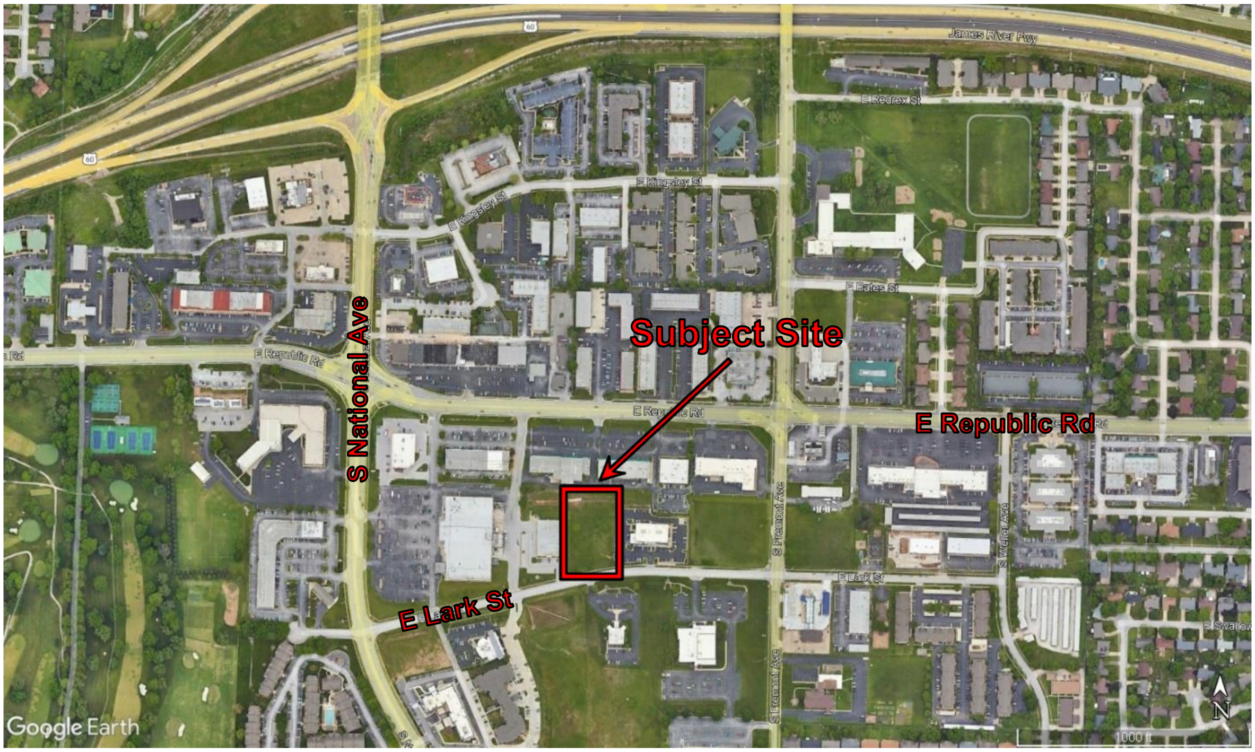
STAYBRIDGE SUITES

1301 EAST LARK STREET

SPRINGFIELD, MISSOURI

1.0 INTRODUCTION

This is the report of the Geotechnical Investigation performed for the proposed Staybridge Suites located at 1301 East Lark Street in Springfield, Missouri. This investigation was authorized by a revised letter proposal dated November 11, 2022, and signed by Mr. Bruce Farris, representing Siraff, Inc. The approximate site location is shown below:



The purpose of the Geotechnical Investigation was to provide information for foundation design and construction planning and to aid in site development. Palmerton & Parrish Inc.'s (PPI) scope of services included field and laboratory investigation of the subsurface conditions in the vicinity of the proposed project site, engineering analysis of the collected data, development of recommendations for foundation design and construction planning, and preparation of this engineering report.

2.0 PROJECT DESCRIPTION

Item	Description
Site Layout	See Figure 1: Boring Location Plan
Building	• Four stories in height; • Slab-on-grade floor system; • Approximately 15,300 square feet; and • Finish Floor Elevation of ±1293.66 feet.
Pavements	Parking and drive lanes anticipated on the north, east, and west sides of the building.
Retaining Walls	Anticipated along the north side and along portions of the east and west sides.
Foundation Loadings	Light to moderate.
Floor Slab Loadings	Light.
Grading	The proposed building is anticipated to have fill depths pf 0.5 to 6.0 feet within the building footprint. Minimal depths of cut and/or fill are anticipated surrounding the building footprint.

3.0 SITE DESCRIPTION

Item	Description
Physical Location	1301 East Lark Street in Springfield, Missouri
Latitude: Longitude: (± Center of Project Site)	37.136131° -93.274881°
Available Historic Aerial Photography	Little to no changes to the subject site are visible from readily available Google Earth Aerial Imagery dating back to 1990.
Current Ground Cover	The site is primarily a grass-covered area.
Existing Topography	The site is moderately sloped with increasing elevations to the south.
Drainage Characteristics	Fair.

4.0 SUBSURFACE INVESTIGATION

Subsurface conditions were investigated through completion of twelve (12) subsurface borings and subsequent laboratory testing.

4.1 Subsurface Borings

Boring locations were selected and staked in the field by PPI using a site plan provided by the Client. Approximate boring locations are shown on Figure 1, Boring Location

Plan. The Missouri One-Call System was notified prior to the investigation to assist in locating buried public utilities.

Logs of the borings showing descriptions of soil and rock units encountered, as well as results of field tests, laboratory tests, and a “Key to Symbols” are presented in Appendix II.

Borings were drilled on April 17 and 18, 2023, using 4.5-inch O.D. continuous flight augers powered by a track-mounted drill-rig. Soil samples were collected at 2.5 to 5-foot centers during drilling. Soil sample types included split spoon samples collected while performing the Standard Penetration Test (SPT) in general accordance with ASTM D1586 and thin-walled Shelby tubes pushed hydraulically in advance of drilling in accordance with ASTM D1587. Please refer to Appendix III for general notes regarding boring logs and additional soil sampling information.

4.2 Laboratory Testing

Collected samples were sealed and transported to the laboratory for further evaluation and visual examination. Laboratory soil testing included the following:

- Moisture Content (ASTM D2216);
- Unconfined Compressive Strength (ASTM D2166);
- Atterberg Limits (ASTM D4318); and
- Pocket Penetrometers.

Laboratory test results are shown on each boring log in Appendix II and are summarized in the following table.

Boring	Depth (ft.)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Moisture Content (%)	USCS Symbol	Cohesion (psf)	Dry Unit Wt. (pcf)
4	6.0	82	26	56	48.3	CH	6,326	71.2
5	6.0	83	27	56	44.5	CH	6,643	75.1

5.0 SITE GEOLOGY

The general site area is underlain at depth by Osagean Series Bedrock. This unit characteristically consists of limestone with some amount of chert and dolomite. Trace shales are also noted within this series. Overburden soils are usually composed of red clay and chert and are residual having developed from physical and chemical weathering of the parent limestone. The chert fragments were interbedded with the limestone but are much more resistant to weathering and retain rock-like properties. The contact between comparatively unweathered bedrock and the residual soils is usually abrupt.

The general site area is located within the Ozarks Physiographic Region of Missouri, which is characterized by rugged to rolling hill terrain, meandering streams and karst topography. Karst topography forms over areas of carbonate bedrock where groundwater has solutionally enlarged openings to form a subsurface drainage system. Springs, caves, losing streams and sinkholes are common in karst areas. Sinkholes are defined as a depression in the landscape with an internal drainage system.

Based upon readily available digital topographic information, as well as conditions encountered within the borings drilled, no indications of sinkhole activity was identified. However, the Owner and contractor should be aware that it is possible for karst features to be encountered at the project site during construction. If a karst feature is identified during site grading, PPI should be contacted immediately for evaluation on a case-by-case basis.

6.0 GENERAL SITE SUBSURFACE CONDITIONS

Based upon subsurface conditions encountered within the borings drilled at the project site, generalized subsurface conditions are summarized below. Soil stratification lines on the boring logs indicate approximate boundary lines between different types of soil units based upon observations made during drilling. In-situ transitions between soil types are typically gradual.

6.1 Soils

Based on the results of the subsurface exploration, the subject site primarily consists of fat clay (CH) soils with variable amounts of gravel and sand. The surface of the site is covered in approximately 3.0 to 6.0 inches of topsoil containing roots from vegetation. Beneath the topsoil is a layer of lean clay (CL) extending to typical depths of 1.0 to 2.5 feet below the ground surface where it transitions into fat clay. Variable amounts of gravel and sand were noted in the fat clay material. The fat clay layer extended to boring termination depths.

6.2 Groundwater

Shallow groundwater was not observed within the borings on the date drilled. Groundwater levels should be expected to fluctuate with changes in site grading, precipitation, and regional groundwater levels. Groundwater may be encountered during wetter periods.

7.0 EARTHWORK

7.1 Site Preparation

Grading plans for the proposed building were not provided. Fill depths ranging from 0.5 to 6.0 feet are anticipated to be required to provide finish subgrade elevations within the building footprint. Minimal to moderate depths of cut and/or fill are anticipated to be required to provide finish subgrade elevations outside of the building footprint. However, due to the fill amounts anticipated at the proposed site, the grade of the parking area may be lowered along the northwestern, northern, and northeastern sides. The initial phase of site preparation should include the steps listed below:

- **It is recommended that a representative from PPI be present during site preparation to help identify the conditions described below**;
- Stripping and removal of all topsoil and vegetation as described in Section 7.2;

- Areas of lean clay containing little to no sand/gravel content may be sensitive to moisture and require over excavation and replacement or stabilization if exposed to rain, excessive moisture, or repeated traffic as described in Section 7.3;
- Fat Clays (CH) with less than 30% gravel/sand content may be encountered within foundation and floor slab bottoms in isolated areas and should be remediated as described in Section 7.4; and
- All areas scheduled to receive new fill should be proof-rolled as described below**.** Fill should not be placed on a frozen subgrade.

Proof-rolling consists essentially of rolling the ground surface with a loaded tandem axle dump truck or similar heavy rubber-tired construction equipment and noting any areas which rut or deflect during rolling. All soft subgrade areas identified during proof-rolling should be undercut and replaced with compacted fill as outlined below. Proof-rolling, undercutting, and replacement should be monitored by a qualified representative of the Geotechnical Engineer. The depth and areal extent of undercutting, if any, should be minimal but will be largely dependent upon the time of year and related soil moisture conditions. If construction is initiated during wetter spring or winter months, the requirement for undercutting soft surficial soils below normal topsoil stripping should be anticipated and reflected in contract documents. As previously mentioned, lean clays at the project site are moisture sensitive and may pose difficulties regarding subgrade stability and proper compaction.

7.2 Topsoil

Topsoil was noted in the subsurface exploration to depths between 3.0 to 6.0 inches below the ground surface. Root zones may extend deeper than those noted in the borings. Due to the influence of vegetation, this material should be stripped from construction areas and stockpiled for use in non-structural areas or removed from the site. It should be noted that the use of the term topsoil within this report is for site construction and does not imply that the material is suitable for sale as topsoil.

7.3 Soft Surficial Soils

As previously stated, areas of lean clay were noted in all borings and extended to depths ranging from 1.0 to 2.5 feet below the ground surface. Generally, these materials may be stable during dry weather; however, these materials are anticipated to be sensitive to the addition of moisture and to construction traffic. During wet seasons or rain events or when exposed to repeated construction traffic, the near surface lean clay soils may become unstable and require over excavation and replacement or stabilization. If this condition does develop and unstable conditions persist, options for remediations include:

- Scarify and recompact;
- Removal and replacement with controlled select fill;
- Stabilization using large size (4-8-inch top size) stone;
- Stabilization using geogrid and aggregate baserock; and
- Chemical stabilization.

The amount of over-excavation will be dependent upon conditions encountered during construction but is anticipated to be widespread if required.

7.4 Moderate Volume Change Material

Based upon past experience with soils near the project site, fat clay (CH) soils with less than 30% gravel/sand content are anticipated to exhibit moderate swell potential if allowed to dry and become saturated. The excessive swelling can cause cracks in foundations, concrete slabs, and pavements to form. These soils were typically encountered at deeper depths within the borings drilled with the exception of Boring 6, where they were encountered at a depth of 1 foot below the existing ground surface.

Where these materials are present in foundation and pavement bottoms, these soils should be moisture conditioned and kept above optimum moisture content as shown in the sections below.

Where these materials are presented within floor slab areas, the fat clay soils should be undercut sufficient to provide a minimum of 2 feet of Low Volume Change (LVC) material (natural or controlled fill) as classified in Section 7.7. In addition, the drainage layer below floor slabs may be considered LVC material. However, this is anticipated to be an isolated condition. **Based upon the anticipated FFE and approximate elevations from Google Earth, this condition may be encountered in the area of Boring 6.**

7.5 Inclement Weather

If construction is initiated during wetter months, the requirement for undercutting soft surficial soils below normal site stripping should be anticipated and reflected in contract documents in areas where new construction is anticipated for the remodel. Undercut depths on the order of 2 or more ft. are considered possible within the development area. The shallow lean clay subgrade at the site is known to significantly lose strength when saturated and disturbed by construction equipment. Further, material removed from undercuts may not be suitable for use as compacted fill due to high soil moisture if poor drying conditions (cool temperatures and/or frequent precipitation) occur during site grading. If the construction schedule will not permit delay for better drying conditions, the project budget should include an allowance for subgrade undercut and replacement soil material containing appreciable quantities of chert or sand and gravel from an off-site borrow area that meet the requirements above. As an alternate to select fill, rock fill subbase (4 to 6-inch top size stone) may be placed to improve subgrade stability.

7.6 Scarifying and Recompacting

Subgrade areas approved after proof-rolling should be scarified to a depth of at least 8 inches and soil moisture adjusted and compacted to comply with project specifications.

7.7 Fill Material Types

Fill Type[1]	USCS Classification	Acceptable Location for Placement
Low Volume Change (LVC) Engineered Fill[2]	CL, GC, or SC (LL < 50%)	All locations and elevations
On-Site Natural Soils	CL	All locations and elevations
	CH	See Note 3
Potential Borrow Material	CL, SC, & GC	All locations and elevations
	CL-CH & CH	See Note 3
Rock Fill[4]	GW	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris and contain maximum rock size of 4 to 6 in. Frozen material should not be used and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to its use.
2. Non-shaley, low plasticity cohesive soil or granular soil having at least 15% low plasticity fines.
3. CH clays with a Liquid Limit equal to or above 50% are considered suitable for use as controlled fill, only if the percentage of rock fragments exceeds 35% or if placed 2 feet below shallow foundations, pavements, or slab areas.
4. If rock fill will be utilized at the project site see Section 7.7.1.
5. **Caution should be exercised when utilizing on-site lean clays as fill material. These soils are moisture sensitive and may not provide a stable subgrade even when properly compacted when soil moisture is above optimum.**

7.7.1 Rock Fill

If rock is to be used as the primary filling medium, embankments should be constructed using rock having maximum dimensions in excess of 4 inches, but no greater than 8 inches. Rock material should be placed in horizontal layers having a thickness of approximately the maximum size of the larger rock comprising the lift, but not greater than 12 inches. Rocks or boulders too large to permit placing in a 12-inch-thick lift should be reduced in size as necessary to permit placement or be bladed over the edge of the fill and not used in the compacted fill. Rock fill should not be dumped into place but should be distributed in horizontal lifts by blading and dozing in such a manner as to ensure proper placement into final position in the embankment. Finer material including rock fines and limited soil fines should be worked into the rock voids during this blading operation. Excessive soil and rock fine particles preventing interlock of cobble and boulder sized rock should be prohibited. Rock fill should be consolidated by a minimum of three (3) passes of a large diameter self-propelled vibratory compactor. Terminal fill slopes using rock may be constructed 1.5 horizontal to 1 vertical for fill height of 15 feet or less. The testing of rock fill quality should include the requirements that a representative of the Geotechnical Engineer be present daily, but not necessarily continuously during the placement of the fill to observe the placement of rock fill in order to determine fill quality and to observe that the contractors work sequence is in compliance with this specification. Progress reports indicative of the quality of the fill should be made at regular intervals to the Owner. If improper placement procedures are observed during the placement of the fill the Geotechnical Engineer should inform the Contractor, and no additional fill should be permitted on the affected area until the condition causing the low densities has been corrected and the fill has been reworked to obtain sufficient density.

7.8 Compaction Requirements

Item	Description
Subgrade Scarification Depth	At least 8 inches
Fill Lift Thickness	8-inch (loose)
Compaction Requirements[1]	95% Standard Proctor Density (ASTM D-698)
Moisture Content	• ± 2% optimum moisture for CL, SC, or GC soil types; or • 0 to 4% above optimum for CH soil types
Recommended Testing Frequency	• One (1) Field Density (compaction) test for each 2,500 sq. ft. of fill within building areas; • One (1) Field Density (compaction) test per 5,000 sq. ft. of fill within paving areas; and • A minimum of three (3) tests per lift.
1. We recommend that engineered fill (including scarified compacted subgrade) be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.	

7.9 Landscaping & Site Drainage

Discharge from roof downspouts should be collected and diverted well away from the building perimeter and incorporated into the design plans. Rapid, efficient runoff away from the building should also be provided. In addition, landscaping requiring frequent watering should be prohibited adjacent to building foundations.

In addition, provisions should be implemented to reduce the potential for large fluctuations in moisture within the subgrade soils adjacent to the structure. Ponding of surface water immediately adjacent to the structure and pavement can significantly increase subgrade moisture and may result in undesirable subgrade movement. As previously mentioned, careful consideration should be given to the landscaping and drainage elements to be installed at the project site adjacent to building and pavement areas. **Trees and some large bushes can draw significant moisture from the subgrade soils, resulting in shrinkage and subsequent foundation/pavement movement.**

7.10 Earthwork Construction Considerations

Once grading and filling operations have been completed, the moisture within the subgrade should be maintained and soils not be allowed to dry and desiccate prior to construction of floor slabs and footings. Grading of the site should be performed in such a manner so that ponding of surface water on prepared subgrade or in excavations is avoided. During construction, if the prepared subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be scarified or removed, moisture conditioned and recompacted prior to floor slab construction.

7.11 Excavations

Based upon the subsurface conditions encountered during this investigation, the on-site soils typically classify as Type C in accordance with OSHA regulations. Temporary excavations in soils classifying as Type C with a total height of less than 20 feet should be cut no steeper than 1.5H:1V in accordance with OSHA guidelines. Confirmation of soil classification during construction, as well as construction safety (including shoring, if required), is the responsibility of the contractor.

8.0 FOUNDATIONS

8.1 Building Foundations

Based upon the subsurface conditions encountered near the proposed building and anticipated site grading, footings for the proposed building are anticipated to bear in stiff natural soils or controlled fill. As stated previously, fat clays (CH) within footing bottoms should be moisture conditioned in accordance with Section 7 prior to footing construction to reduce the potential for swell. Please refer to the section below for recommendations regarding shallow foundations.

8.2 Shallow Foundation Design Recommendations

Description	Column (Spread Footing)	Wall (Continuous Footing)
Net allowable bearing pressure[1]	• Native Soil: 2,500 psf • Controlled Fill: 2,500 psf	• Native Soil: 2,000 psf • Controlled Fill: 2,000 psf
Minimum dimensions	2.5 feet	1.5 feet
Minimum embedment below finished grade for frost protection and variation in soil moisture[2] (footings on soil)	2.5 feet	2.5 feet
Estimated total settlement[3]	1 inch or less	1 inch or less
Allowable passive pressure[4]	600 psf	600 psf
Coefficient of sliding friction[5]	0.4 (natural soils/controlled fill)	0.4 (natural soils/controlled fill)

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The recommended pressure considers all unsuitable and/or soft or loose soils, if encountered, are undercut and replaced with tested and approved new engineered fill. Footing excavations should be free of loose and disturbed material, debris, and water when concrete is placed. A factor of safety value of 3 has been applied to these values.
2. For perimeter footings and footings beneath unheated areas.
3. The foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.
4. Allowable passive pressure value considers a factor of safety of about 2. Passive pressure value applies to undisturbed native clay or properly compacted fill. If formed footings are constructed, the space between the formed side of a footing and excavation sidewall should be cleaned of all loose material, debris, and water and backfilled with tested and approved fill compacted to at least 95% of the material's Standard Proctor dry density. Passive resistance should be neglected for the upper 2.5 feet of the soil below the final adjacent grade due to strength loss from freeze/thaw and shrink/swell.
5. Coefficient of friction value is an ultimate value and does not contain a factor of safety.

8.3 Uplift

Resistance of shallow spread footings to uplift (U_p) may be based upon the dead weight of the concrete footing structure (W_C) and the weight of soil backfill contained in an inverted cone or pyramid directly above the footings (W_S). The following parameters may be used in design:

Description	Weights
Weight of Concrete (W_c)	150 pcf
Weight of Soil Resistance (W_s)	100 pcf
Weight for on-site soils placed in accordance with Section 7	

The base of the cone or pyramid should be the top of the footing and the pyramid or cone sides should form an angle of 30 degrees with the vertical. Allowable uplift capacity (U_p) should be computed as the lesser of the two (2) equations listed below:

$$U_P = (W_S/2.0) + (W_C/1.25) \text{ or } U_P = (W_S + W_C)/1.5$$

9.0 RETAINING WALLS

Based upon the information provided by the Design Team, site retaining walls may be constructed at this site. The following information is provided for design of retaining walls.

Foundations for retaining walls should be designed using the parameters provided above in Section 8. Wall backfill should consist of either free-draining crushed stone or lean clay with appreciable (>35%) chert fragments, depending upon wall type. Lateral earth pressures behind retaining walls may be computed using the equivalent fluid pressures summarized in the table below, for drained backfill conditions. Free-draining crushed stone backfill should be placed within the entire zone commencing 1 ft. out from the base of the wall and projecting 30 degrees from the vertical, in order for the equivalent fluid pressures presented in the table to apply. Equivalent fluid pressures for backslope conditions that vary between level and 2 Horizontal to 1 Vertical (2H:1V) may be interpolated between the values presented in the table. Note that structural design for unrestrained walls should allow wall rotation at the top of the wall equivalent to 1/240th of the wall height.

Regardless of the wall type selected, a minimum 1 ft. thick chimney drain consisting of free draining gravel should be placed against the backfilled wall face. If a concrete wall is selected, a geosynthetic drainage mat may also be installed adjacent to the wall if lean clay backfill is utilized to ensure removal of subsurface water. A drain system consisting of perforated PVC or HDPE pipe should be installed at the base of the wall to collect and remove subsurface water from either the free-draining crushed stone or the geosynthetic drainage mats.

	Equivalent Fluid Pressure (pcf) – Drained Backfill Conditions			
	Level Backfill		Sloped Backfill (2H:1V)	
Backfill Type	**Restrained Walls**	**Unrestrained Walls**	**Restrained Walls**	**Unrestrained Walls**
Compacted Lean Clay; with >35% Retained on No. 4 Sieve	70	45	80	55
Clean Crushed Stone	50	35	60	45
Rock Fill (Free-Draining)	50	35	60	45

10.0 SEISMIC CONSIDERATIONS

Code Used	Site Classification
2018 International Building Code (IBC)[1]	D
1. In general accordance with the *2018 International Building Code*, Section 1613	

11.0 FLOOR SLABS

A slab-on-grade or slab-on-fill floor system is considered appropriate at the site based upon subsurface conditions encountered and future site grading. Listed below are key considerations for design purposes of the floor slab.

- Prior to the placement of **controlled** fill, the subsurface should be proof-rolled and approved. Areas not passing a proof-roll should be over excavated and replaced. **Undercutting of the shallow, moisture sensitive lean clays present at this site is anticipated and should be included in project budgets and schedules if slabs are constructed to near existing grade**;
- Isolated fat clays (CH) with less than 30% gravel/sand encountered in floor slab bottoms (anticipated in the area of Boring 6) should be undercut sufficient to provide 2 feet of LVC material in accordance with Section 7.4 of this report;
- Prior to the placement of **controlled** fill, natural soils should be scarified, moisture content adjusted, and re-compacted in accordance with Section 7 of this report; and

- Prior to slab placement, soil moisture should be adjusted and maintained within the parameters specified in Section 7 of this report.

Placement of 4 or more inches of compacted free-draining granular base course below slabs that are not below grade is recommended to limit moisture rise through slabs and to improve slab support, particularly at joints. An impervious moisture barrier consisting of 6-mil plastic sheeting or equivalent should be provided in accordance with the 2018 IBC. Use of a 10-mil vapor barrier is recommended below all slab areas with an intended use sensitive to slab moisture.

12.0 PAVEMENT

Pavement subgrades should be prepared in accordance with Section 7 of this report. **It is considered essential that moisture content be adjusted and maintained above optimum for all exposed CH clays to limit the potential for shrink/swell.** It is anticipated that any new pavements associated with this project will be constructed of either an asphaltic concrete wearing surface placed over a base or a rigid Portland Cement Concrete pavement over a granular base.

12.1 Flexible Pavement

If asphaltic paving is selected, the aggregate base may be a granular compacted crushed limestone with a gradation and quality conforming to the requirements of the Missouri Department of Transportation, Standard Specification 1007 for either Type 1 or Type 5 aggregates. The maximum lift thickness for the granular base is 4 inches. Granular base thicknesses in excess of 4 inches should be placed in multiple lifts with each lift being of approximate equal thickness. The granular base should be compacted to at least 100% of Standard Proctor Compaction (ASTM D698). The base may also be a bituminous base.

Asphaltic concrete, both base and surface, should conform to the applicable gradational requirements of MoDOT Standard Specification 401 to 403 except that sampling for testing compliance during laydown should be from hot mix samples taken behind the paver. Asphaltic concrete should be compacted to 92 to 96% of Maximum

Theoretical Specific Gravity (ASTM D2041). 95% of 50-Blow Marshall compaction is also accepted as a minimum compaction if the void content (Va) is within the specification value range. Substitution of an appropriate Superpave Mix Design (MoDOT Section 403) is permitted. SP-190C or SP-250C can be used in place of the bituminous base. SP-190C or SP-125C may be used for the surface.

All asphalt mixes should comply with the following density, gradation, oil content and volumetric requirements during laydown. However, all Owners, Developers and Contractors should be aware that minor changes in conditions (environmental, materials or mechanical) during production can cause variations in the volumetric properties of an asphalt mix design. Volumetric properties which vary slightly from the requirements below should be reported to the producer to allow plant adjustments. Asphalt mix properties which consistently vary appreciably from the requirements in the following table should be considered deficient. All bituminous mix designs should have been prepared or verified within six (6) months of the date of placement on this project and should recognize the tendency of the mineral aggregate to “fine up” in the mixer.

Asphalt Properties & Recommended Specifications				
Tested Property	**Test Method**	**Testing Frequency**	**Sample Source or Test Location**	**Specification**
Mixture Temperature		As Needed	N/A	For Informational Purposes
Temperature of Base & Air		As Needed	N/A	For Informational Purposes
Max Density (% of Theoretical Maximum Density)	AASHTO T166 or ASTM D2041	1 Test Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	Location selected by testing lab at least 2 ft. from joint	92 to 96%
Gradation	AASHTO T27	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	[1]MoDOT 401.3
Combined Aggregate Asphalt Content	AASHTO T308	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	± 0.3% from Mix Design
VMA @ N_{des} Gyrations (Voids in Mineral Aggregate)	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	>13.0% for Base >13.5% for BP-1 >14.0% for BP-2 >15.0% for BP-3
V_a @ N_{des} Gyrations (Air Voids)	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	± 1% From Mix Design
Percent Voids Filled	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	60 – 80%
Theo. Max SG of the Mixture	AASHTO T209	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	N/A
Thickness	AASHTO T148	1 Test Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	As directed by Engineer	Total Asphalt Thickness to be No Less than 0.5" from Specified Thickness

1. See MoDOT 403.3.1 for SP Mixes

12.2 Rigid Pavement

If rigid concrete paving is selected a minimum 4-inch-thick granular base compacted to 100% of Standard Proctor should be placed on the prepared subgrade. The Portland Cement Concrete mix should have a minimum 28-day compressive strength of 4000 pounds per square inch (psi). Concrete should be placed at a low slump (1 to 3 inches) and have an entrained air content of 5 to 7%. If an increased slump is desired, use of Super Plasticizer is recommended. The use of 6x6-inch welded wire mesh is also recommended for reinforcement.

12.3 Pavement Thickness

A pavement thickness would best be computed if traffic frequencies and wheel loadings were provided to us, but a typical pavement design for this type of facility would generally generate a Structural Number of 3.0 to 3.5 within heavy duty areas and 2.4 to 2.6 within light duty areas, depending on the subgrade conditions. The following table presents corresponding typical flexible and rigid pavement thicknesses using the general Structural Numbers. The pavement thicknesses provided below are conservative and can be re-evaluated if a final grading plan, traffic frequencies and wheel loadings are provided, if desired.

Pavement Type	Anticipated Traffic Frequency	Asphaltic Surface (in.)	Asphaltic Base (in.)	Concrete Thickness (in.)	Aggregate Base (in.)
Flexible Pavement	Heavy Duty	3.0	4.0	-	6.0
	Heavy Duty w/ Tensar TX5 Geogrid*	3.0	3.0	-	6.0
	Light Duty	2.0	2.0	-	6.0
	Light Duty w/ Tensar TX5 Geogrid*	3.0	-	-	6.0
Rigid Pavement	Heavy Duty	-	-	7.0	4.0
	Light Duty	-	-	5.0	4.0
*Geogrid to consist of Tensar TX5, installed below aggregate baserock section per manufacturer's recommendations.					

13.0 CONSTRUCTION OBSERVATION & TESTING

The construction process is an integral design component with respect to the geotechnical aspects of a project. Since geotechnical engineering is influenced by variable depositional and weathering processes and because we sample only a small portion of the soils affecting the performance of the proposed structure, unanticipated or changed conditions can be disclosed during grading. Proper geotechnical observation and testing during construction is imperative to allow the Geotechnical Engineer the opportunity to evaluate assumptions made during the design process. Therefore, we recommend that PPI be kept apprised of design modifications and construction schedule of the proposed project to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study. We recommend that during construction all earthwork be monitored by a representative of PPI, including site preparation, placement of all engineered fill and trench backfill, and all foundation excavations as outlined below.

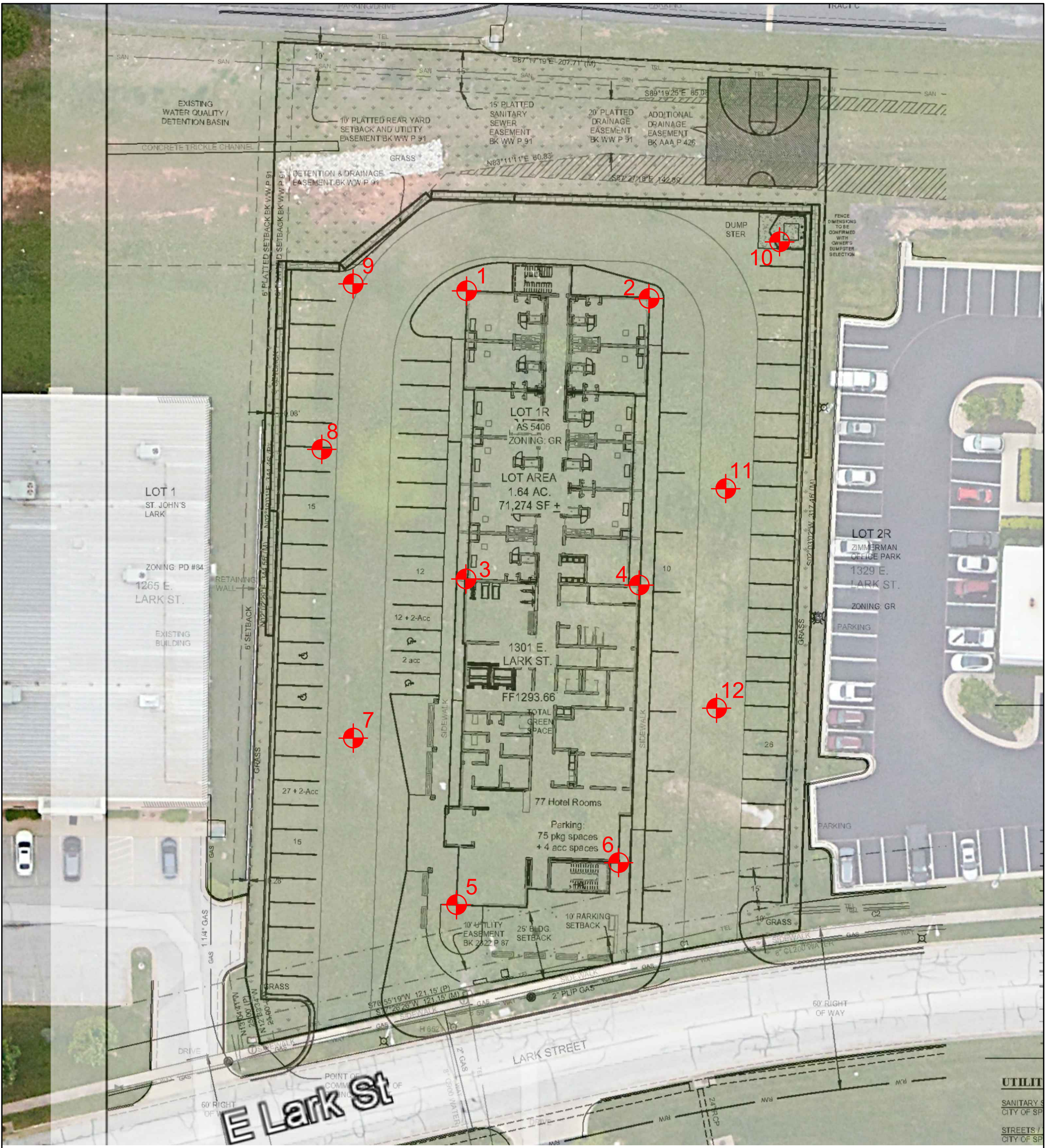
- An experienced Geotechnical Engineer or Engineering Technician of PPI should observe the subgrade throughout the proposed project site immediately following stripping to evaluate the native clay, identify areas requiring undercutting, and evaluate the suitability of the exposed surface for fill placement;
- An experienced Engineering Technician of PPI should monitor and test all fill placed within the building and pavement areas to determine whether the type of material, moisture content, and degree of compaction are within recommended limits;
- An experienced Technician or Engineer of PPI should observe and test all footing excavations. Where unsuitable bearing conditions are observed, remedial procedures can be established in the field to avoid construction delays; and
- The condition of the subgrade should be evaluated immediately prior to construction of the building floor slabs to determine whether the moisture content and relative density of the subgrade soils are as recommended.

14.0 REPORT LIMITATIONS

This report has been prepared in accordance with generally accepted practices of other consultants undertaking similar studies at the same time and in the same geographical area. Palmerton & Parrish, Inc. observed that degree of care and skill generally exercised by other consultants under similar circumstances and conditions. Palmerton & Parrish's findings and conclusions must be considered not as scientific certainties, but as opinions based on our professional judgment concerning the significance of the data gathered during the course of this investigation. Other than this, no warranty is implied or intended.

APPENDIX I – FIGURES

S:_MASTER PROJECT FILE\2023_MO\S\Siraff, Inc-23-2051-Staybridge Suites, 1301 E. Lark St-Spfld, MO-SUB\Figures\23-2051 Figure 1 - Boring Location Plan.dwg



LEGEND

⌖ Boring Location

SCALE
1" = 50'

Project: Staybridge Suites - Springfield, Missouri
Client: Siraff, Inc.

Boring Location Plan

Date: April 25, 2023

Project Number: 23-2051

PALMERTON & PARRISH, INC.
GEOTECHNICAL AND MATERIALS ENGINEERS/MATERIALS TESTING LABORATORIES/ENVIRONMENTAL SERVICES

FIGURE 1

APPENDIX II – BORING LOGS & KEY TO SYMBOLS

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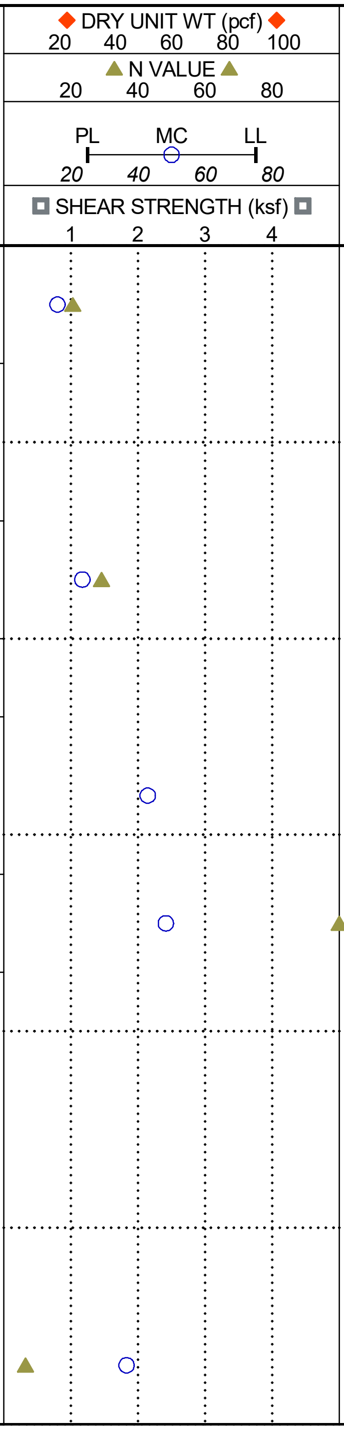
GEOTECHNICAL BORING LOG

BORING NUMBER 1

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/17/23 **COMPLETED** 4/17/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.	TOPSOIL (4") 0.3 ft					
		LEAN CLAY, Trace Gravel, Very Stiff, Brown, Moist (CL) 1.5 ft	SPT 1		3-10-11 (21)	1.5	
2.5		GRAVELLY FAT CLAY, Trace Sand, Very Stiff, Red, Moist (CH)					
			SPT 2		14-16-13 (29)	2.5	
5.0		5.5 ft					
		FAT CLAY, Stiff, Red, Moist (CH)	ST 3	75		2.5	
7.5		- Trace Mottling Below 8.0' 9.0 ft	SPT 4		3-4-54/3"	3	
		CHERT 9.3 ft					
10.0		GRAVELLY FAT CLAY, Trace Mottling, Medium Stiff, Red, Moist (CH)					
12.5							
		15.0 ft	SPT 5		8-4-2 (6)		
15.0		Bottom of borehole at 15.0 feet.					



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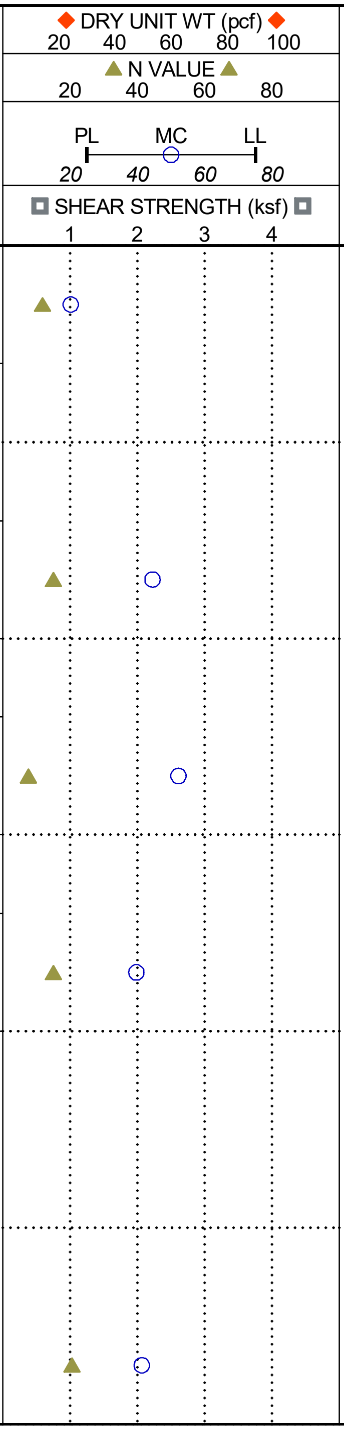
GEOTECHNICAL BORING LOG

BORING NUMBER 2

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/17/23
COMPLETED 4/17/23
SURFACE ELEVATION
BENCHMARK EL.
DRILLER RA
DRILL RIG 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD
CHECKED BY CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.	TOPSOIL (6") 0.5 ft					
		LEAN CLAY, Trace Gravel, Stiff, Brown, Moist (CL) 2.0 ft	SPT 1		2-4-8 (12)	2	
2.5		FAT CLAY, With Gravel, Trace Sand, Stiff, Red, Moist (CH) 6.0 ft	SPT 2		24-11-4 (15)	2	
5.0		FAT CLAY, Trace Mottling, Medium Stiff, Red, Moist (CH) 8.0 ft	SPT 3		2-3-4 (7)	3	
7.5		GRAVELLY FAT CLAY, Trace Sand, Stiff to Very Stiff, Red, Moist (CH)	SPT 4		8-3-12 (15)	1.5	
10.0							
12.5		- With Sand Below 13.5' 15.0 ft	SPT 5		1-18-2 (20)		
15.0		Bottom of borehole at 15.0 feet.					



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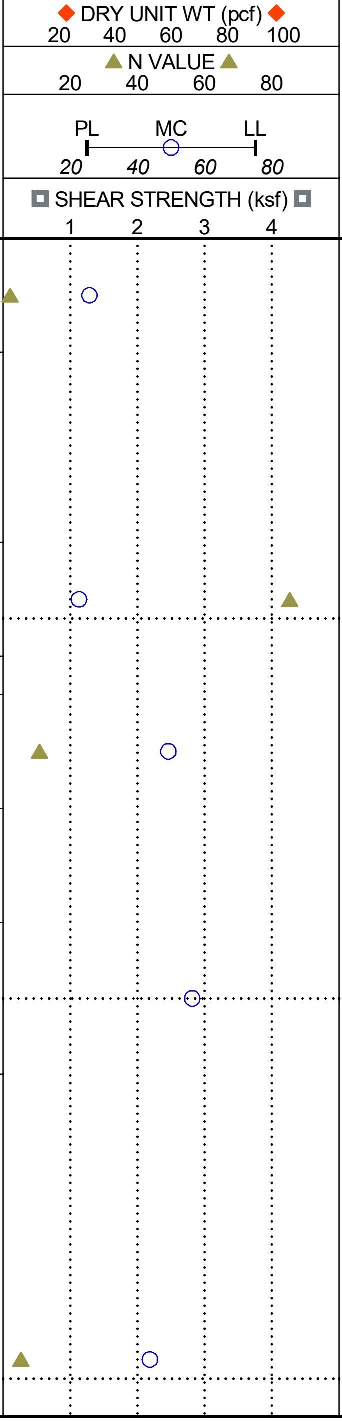
GEOTECHNICAL BORING LOG

BORING NUMBER 3

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/17/23 **COMPLETED** 4/17/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0	CFA - 4.5" O.D.	TOPSOIL (4") 0.3 ft					
		LEAN CLAY, Soft, Brown, Moist (CL) 1.3 ft	SPT 1		1-1-1 (2)	1	
		FAT CLAY, Medium Stiff to Stiff, Red, Moist (CH) 2.5 ft					
5		GRAVELLY FAT CLAY, With Sand, Very Hard, Red, Moist (CH) 5.5 ft	SPT 2		29-38-48 (86)	4	
		FAT CLAY, Trace Mottling, Stiff, Red, Moist (CH)	SPT 3		3-4-6 (10)	3	
10		11.3 ft	ST 4	92		3	
15		FAT CLAY, Trace Gravel, Sand, and Mottling, Medium Stiff, Red, Moist (CH) 15.5 ft	SPT 5		1-4-1 (5)		



Bottom of borehole at 15.5 feet.

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GEOTECHNICAL BORING LOG

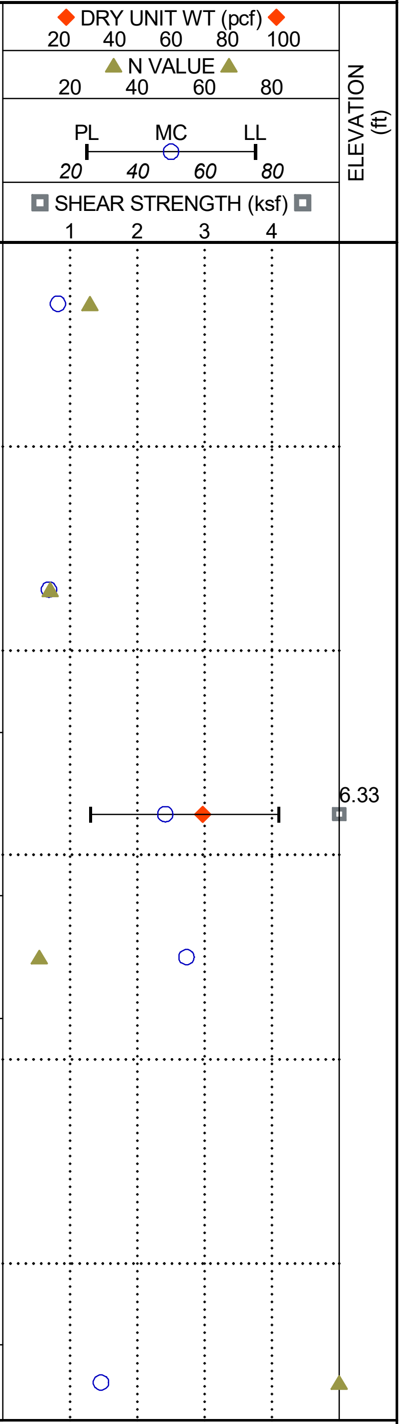
BORING NUMBER 4

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/17/23 **COMPLETED** 4/17/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
0.0	CFA - 4.5" O.D.	TOPSOIL (4") — 0.3 ft				
		LEAN CLAY, Very Stiff, Brown, Moist (CL) - With Gravel Below 0.5' — 2.0 ft	SPT 1		5-8-18 (26)	
2.5		GRAVELLY FAT CLAY, Stiff, Red, Moist (CH) — 4.5 ft	SPT 2		6-6-8 (14)	
5.0		FAT CLAY, Trace Gravel and Mottling, Stiff to Hard, Red, Moist (CH)				
7.5			ST 3	96		4
			SPT 4		3-4-6 (10)	3
10.0		— 12.0 ft				
12.5		GRAVELLY FAT CLAY, Trace Sand, Very Hard, Red, Moist (CH) — 14.4 ft	SPT 5		27-54/5"	2

Bottom of borehole at 14.4 feet.



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GEOTECHNICAL BORING LOG

BORING NUMBER 5

PAGE 1 OF 1

CLIENT Siraff, Inc.

PROJECT NAME Staybridge Suites

PROJECT NO. 23-2051

PROJECT LOCATION Springfield, Missouri

DATE STARTED 4/17/23 **COMPLETED** 4/17/23

SURFACE ELEVATION **BENCHMARK EL.**

DRILLER RA **DRILL RIG** 2014 CME-55

GROUND WATER LEVELS

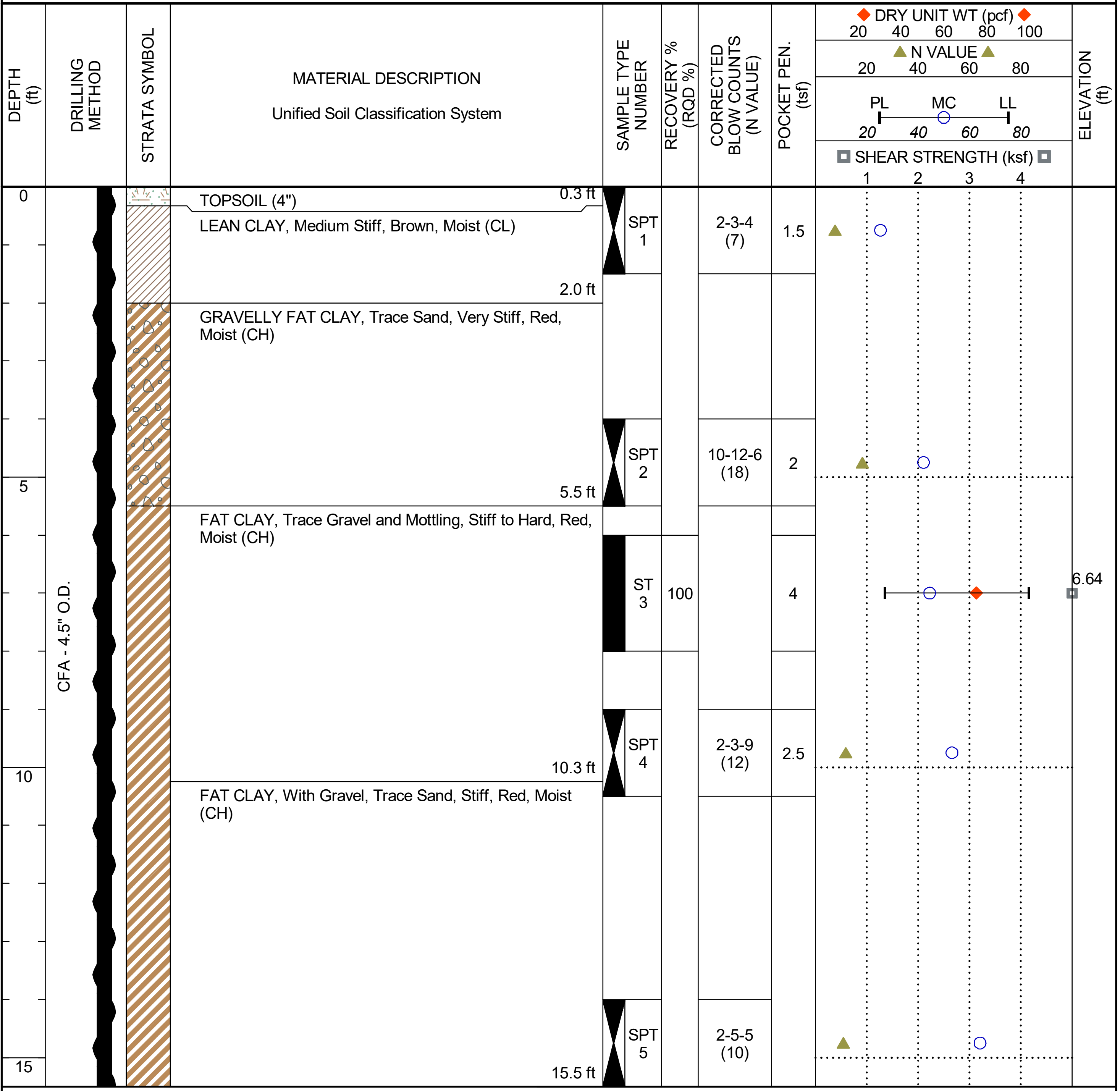
HAMMER TYPE Auto

AT TIME OF DRILLING None

LOGGED BY RD **CHECKED BY** CL

AT END OF DRILLING

NOTES



DEPTH (ft)	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
0.3 ft	TOPSOIL (4")				
2.0 ft	LEAN CLAY, Medium Stiff, Brown, Moist (CL)	SPT 1		2-3-4 (7)	1.5
5.5 ft	GRAVELLY FAT CLAY, Trace Sand, Very Stiff, Red, Moist (CH)	SPT 2		10-12-6 (18)	2
10.3 ft	FAT CLAY, Trace Gravel and Mottling, Stiff to Hard, Red, Moist (CH)	ST 3	100		4
		SPT 4		2-3-9 (12)	2.5
15.5 ft	FAT CLAY, With Gravel, Trace Sand, Stiff, Red, Moist (CH)	SPT 5		2-5-5 (10)	

Bottom of borehole at 15.5 feet.

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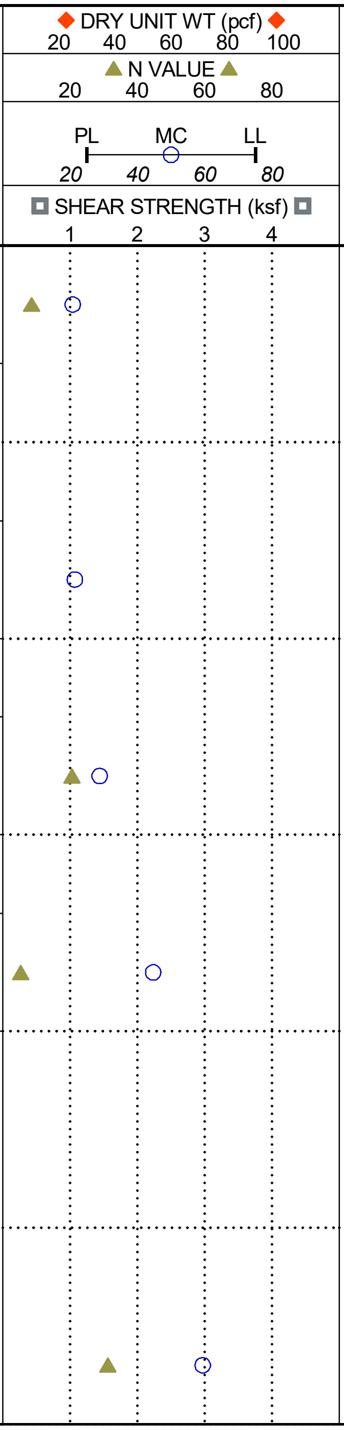
GEOTECHNICAL BORING LOG

BORING NUMBER 6

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/17/23 **COMPLETED** 4/17/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (3") 0.3 ft					
			LEAN CLAY, Medium Stiff, Brown, Moist (CL) 1.0 ft	SPT 1		3-4-4 (8)	3	
			FAT CLAY, Trace Gravel, Medium Stiff to Very Stiff, Red, Moist (CH)					
2.5								
			5.5 ft	ST 2	89		4.5	
5.0			GRAVELLY FAT CLAY, Trace Sand and Mottling, Very Stiff, Red, Moist (CH)					
			8.0 ft	SPT 3		10-13-8 (21)	3	
7.5			FAT CLAY, Trace Mottling, Medium Stiff, Red, Moist (CH)					
				SPT 4		2-2-3 (5)	2.5	
10.0			12.5 ft					
12.5			FAT CLAY, With Gravel, Trace Sand and Mottling, Hard, Red, Moist (CH)					
			15.0 ft	SPT 5		2-4-27 (31)		
15.0			Bottom of borehole at 15.0 feet.					



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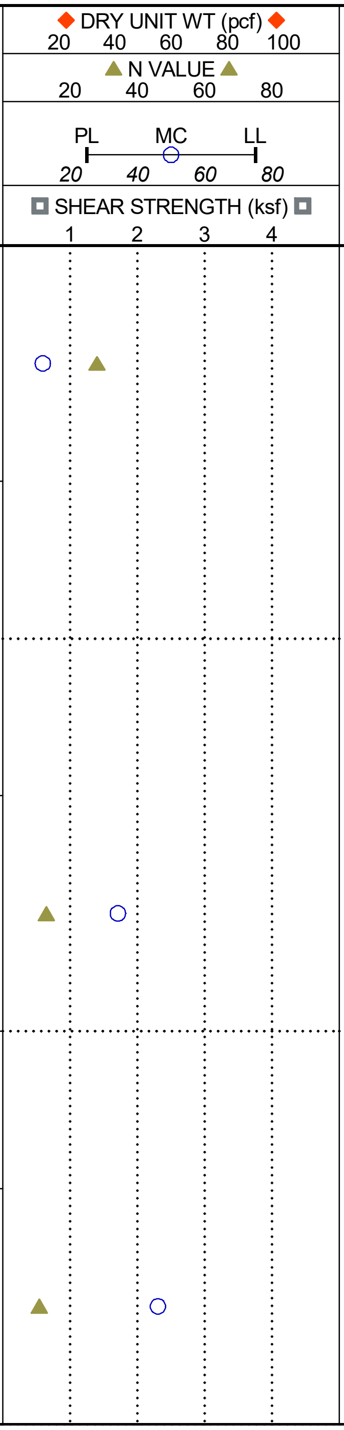
GEOTECHNICAL BORING LOG

BORING NUMBER 7

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/18/23 **COMPLETED** 4/18/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (5") 0.4 ft	SPT 1		4-14-14 (28)	1	
			LEAN CLAY, Stiff, Brown, Moist (CL) 0.7 ft					
			GRAVELLY LEAN CLAY, Very Stiff, Brown, Moist (CL) 2.5 ft					
2.5			FAT CLAY, Trace to Scattered Gravel, Trace Mottling, Stiff, Red, Moist (CH)	SPT 2		5-8-5 (13)	2.5	
5.0				SPT 3		3-4-6 (10)	2.5	
			7.5 ft					
7.5			Bottom of borehole at 7.5 feet.					



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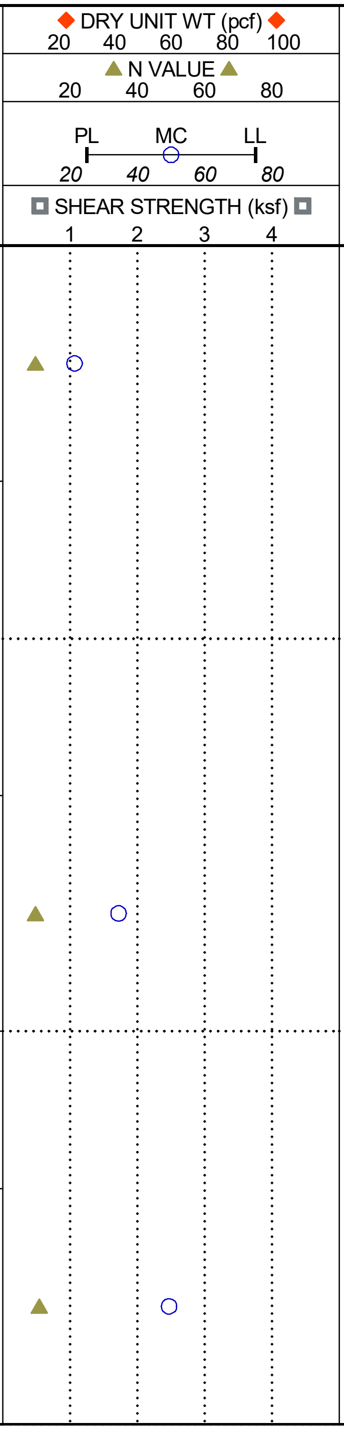
GEOTECHNICAL BORING LOG

BORING NUMBER 8

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/18/23
COMPLETED 4/18/23
SURFACE ELEVATION
BENCHMARK EL.
DRILLER RA
DRILL RIG 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD
CHECKED BY CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (6") 0.5 ft	SPT 1		2-4-5 (9)	2.5	
			LEAN CLAY, Scattered Gravel, Trace Sand, Stiff, Brown, Moist (CL) 1.0 ft					
			FAT CLAY, Scattered Gravel, Stiff, Red, Moist (CH)					
2.5								
				SPT 2		5-4-5 (9)	3	
5.0			5.5 ft					
			FAT CLAY, Trace Mottling, Stiff, Red, Moist (CH) 7.5 ft	SPT 3		4-5-5 (10)	4	
7.5			Bottom of borehole at 7.5 feet.					



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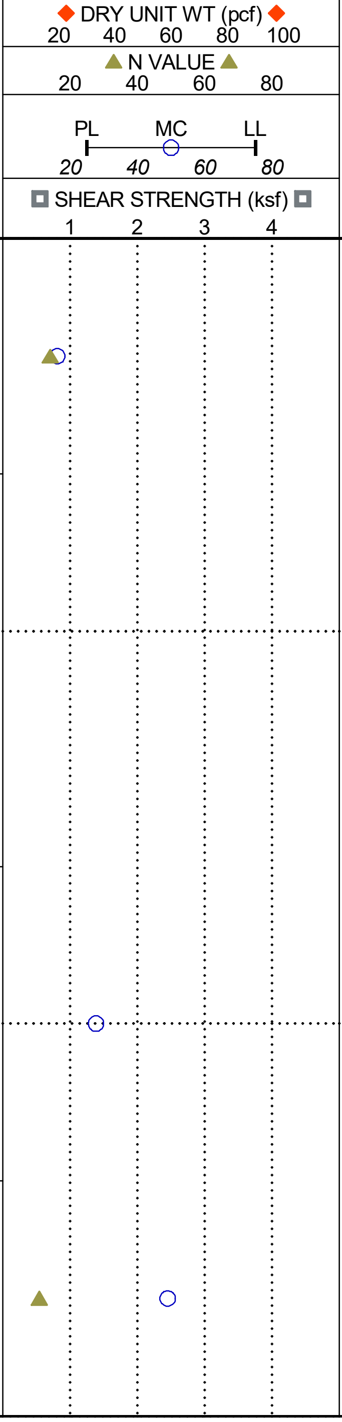
GEOTECHNICAL BORING LOG

BORING NUMBER 9

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/18/23 **COMPLETED** 4/18/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (3") 0.3 ft					
			LEAN CLAY, Stiff, Brown, Moist (CL) 1.0 ft	SPT 1		4-8-6 (14)	4.5	
			FAT CLAY, Trace Gravel, Stiff to Very Stiff, Red, Moist (CH)					
2.5								
5.0				ST 2	54		4.5	
			7.5 ft	SPT 3		3-4-6 (10)	2.5	
7.5			Bottom of borehole at 7.5 feet.					



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GEOTECHNICAL BORING LOG

BORING NUMBER 10

PAGE 1 OF 1

CLIENT Siraff, Inc.

PROJECT NAME Staybridge Suites

PROJECT NO. 23-2051

PROJECT LOCATION Springfield, Missouri

DATE STARTED 4/18/23 **COMPLETED** 4/18/23

SURFACE ELEVATION **BENCHMARK EL.**

DRILLER RA **DRILL RIG** 2014 CME-55

GROUND WATER LEVELS

HAMMER TYPE Auto

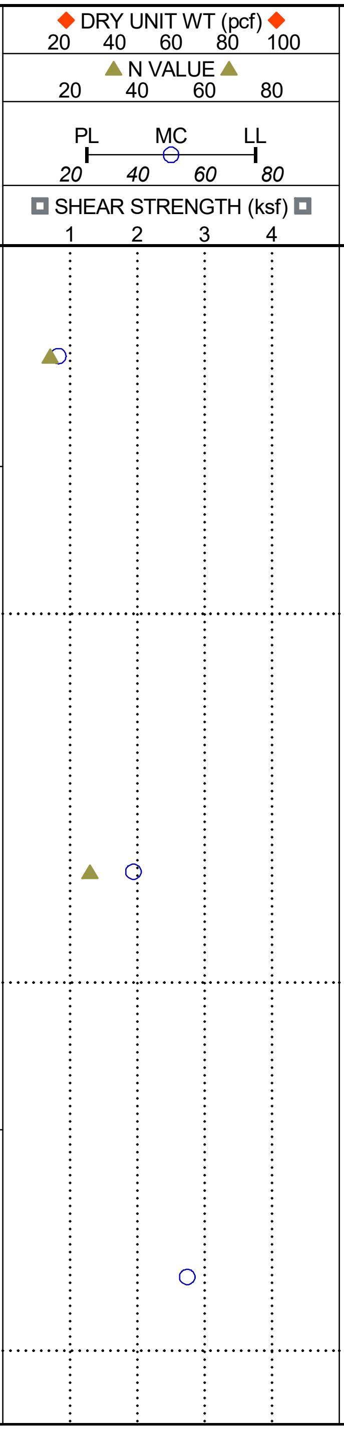
AT TIME OF DRILLING None

LOGGED BY RD **CHECKED BY** CL

AT END OF DRILLING

NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (6") 0.5 ft					
			LEAN CLAY, Stiff, Brown, Moist (CL) 1.5 ft	SPT 1		4-9-5 (14)	3	
2.5			GRAVELLY FAT CLAY, Trace Sand, Very Stiff, Red, Moist (CH) 5.0 ft	SPT 2		12-13-13 (26)		
5.0 7.5			FAT CLAY, Trace Gravel, Very Stiff, Red, Moist (CH) 8.0 ft	ST 3	63		3.5	



Bottom of borehole at 8.0 feet.

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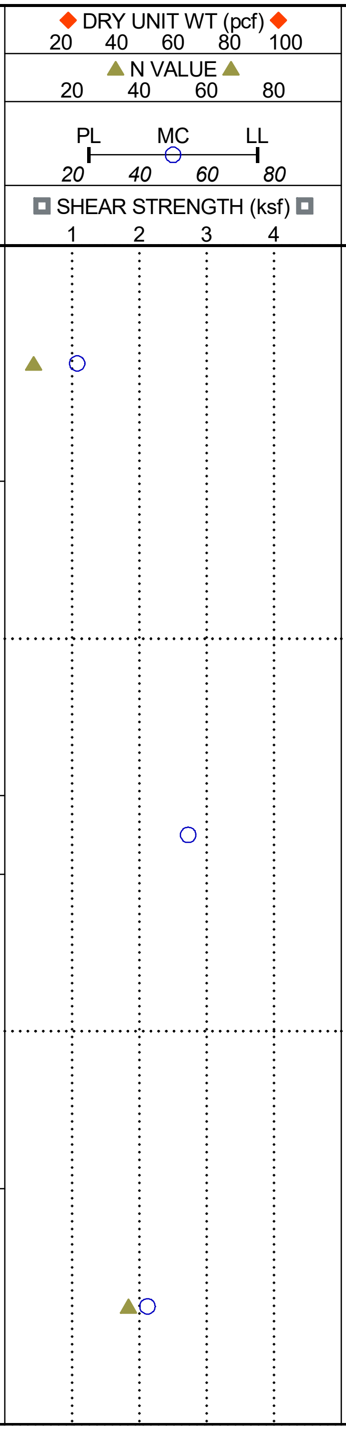
GEOTECHNICAL BORING LOG

BORING NUMBER 11

PAGE 1 OF 1

CLIENT Siraff, Inc.
PROJECT NAME Staybridge Suites
PROJECT NO. 23-2051
PROJECT LOCATION Springfield, Missouri
DATE STARTED 4/18/23 **COMPLETED** 4/18/23
SURFACE ELEVATION **BENCHMARK EL.**
DRILLER RA **DRILL RIG** 2014 CME-55
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY RD **CHECKED BY** CL
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.	TOPSOIL (5") 0.4 ft					
		LEAN CLAY, Trace Gravel, Medium Stiff, Brown, Moist (CL) 1.5 ft	SPT 1		2-4-4 (8)	2.5	
2.5		FAT CLAY, Trace Gravel, Medium Stiff to Stiff, Red, Moist (CH) 5.0 ft	ST 2	100		2.5	
5.0		GRAVELLY FAT CLAY, Scattered Sand, Hard, Red, Moist (CH) 7.5 ft	SPT 3		40-29-8 (37)	2	
7.5		Bottom of borehole at 7.5 feet.					



4168 W. Kearney
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 12

PAGE 1 OF 1

CLIENT Siraff, Inc.

PROJECT NAME Staybridge Suites

PROJECT NO. 23-2051

PROJECT LOCATION Springfield, Missouri

DATE STARTED 4/18/23 **COMPLETED** 4/18/23

SURFACE ELEVATION **BENCHMARK EL.**

DRILLER RA **DRILL RIG** 2014 CME-55

GROUND WATER LEVELS

HAMMER TYPE Auto

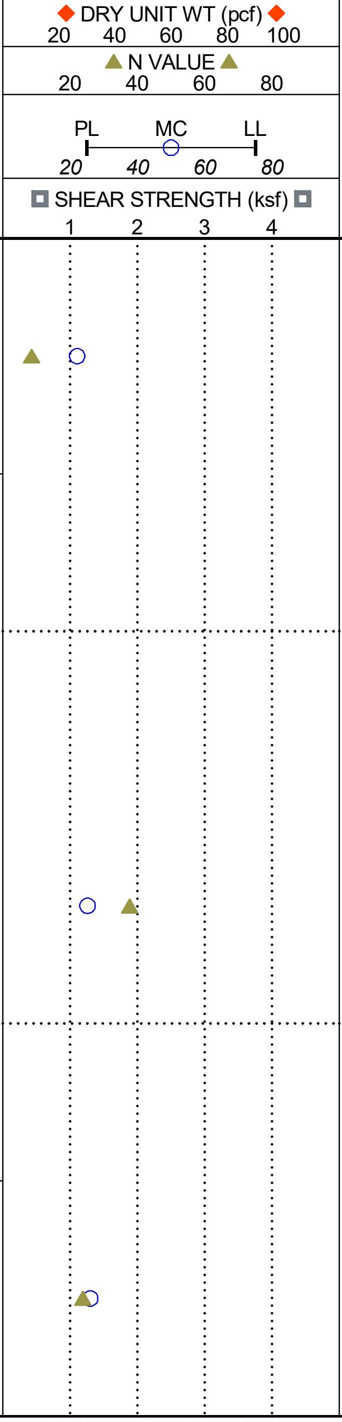
AT TIME OF DRILLING None

LOGGED BY RD **CHECKED BY** CL

AT END OF DRILLING

NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION Unified Soil Classification System	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL (4") 0.3 ft					
			LEAN CLAY, Medium Stiff, Brown, Moist (CL) 1.0 ft	SPT 1		2-4-4 (8)	1.5	
			GRAVELLY FAT CLAY, Trace Sand, Very Stiff to Hard, Red, Moist (CH)					
2.5								
				SPT 2		14-21-17 (38)		
5.0								
			7.5 ft	SPT 3		9-16-8 (24)	3	
7.5			Bottom of borehole at 7.5 feet.					



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KEY TO SYMBOLS

CLIENT Siraff, Inc.

PROJECT NAME Staybridge Suites

PROJECT NO. 23-2051

PROJECT LOCATION Springfield, Missouri

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

▨	CH: USCS High Plasticity Clay
△	CHERT: Chert
▨	CHG: USCS High Plasticity Gravelly Clay
▨	CL: USCS Low Plasticity Clay
▨	CLG: USCS Low Plasticity Gravelly Clay
⁘	TOPSOIL: Topsoil

SAMPLER SYMBOLS

⧗	Standard Penetration Test
■	Shelby Tube

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▼ Water Level After 24 Hours, or as Shown

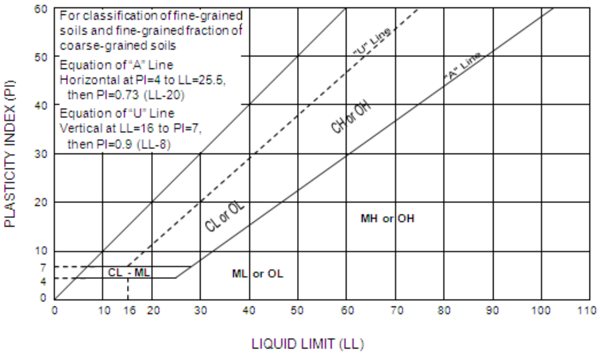
APPENDIX III – GENERAL NOTES

GENERAL NOTES

SOIL PROPERTIES & DESCRIPTIONS

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu)	Pocket Penetrometer Strength	N-Value
	(psf)	(tsf)	(blows/ft)
Very Soft	<500	<0.25	0-1
Soft	500-1000	0.25-0.50	2-4
Medium Stiff	1001-2000	0.50-1.00	5-8
Stiff	2001-4000	1.00-2.00	9-15
Very Stiff	4001-8000	2.00-4.00	16-30
Hard	>8000	>4.00	31-60
Very Hard			>60



Group Symbol	Group Name
CL –	Lean Clay
ML –	Silt
OL –	Organic Clay or Silt
CH –	Fat Clay
MH –	Elastic Silt
OH –	Organic Clay or Silt
PT –	Peat
CL-CH –	Lean to Fat Clay

Plasticity		Moisture	
Description	Liquid Limit (LL)	Descriptive Term	Guide
Lean	<45%	Dry	No indication of water
Lean to Fat	45-49%	Moist	Indication of water
Fat	≥50%	Wet	Visible water

Fine Grained Soil Sub Classification	Percent (by weight) of Total Sample
Terms: SILT, LEAN CLAY, FAT CLAY, ELASTIC SILT	PRIMARY CONSTITUENT
Sandy, gravelly, abundant cobbles, abundant boulders	>30-50]
with sand, with gravel, with cobbles, with boulders	>15-30] – secondary coarse grained constituents
scattered sand, scattered gravel, scattered cobbles, scattered boulders	5-15]
a trace sand, a trace gravel, a few cobbles, a few boulders	<5]
The relationship of clay and silt constituents is based on plasticity and normally determined by performing index tests. Refined classifications are based on Atterberg Limits tests and the Plasticity Chart.	

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	N-VALUE
Very Loose	0-4
Loose	5-10
Medium Dense	11-24
Dense	25-50
Very Dense	≥51

MOISTURE CONDITION	
Descriptive Term	Guide
Dry	No indication of water
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table.

**GRAIN SIZE IDENTIFICATION		
Name	Size Limits	Familiar Example
Boulder	12 in. or more	Larger than basketball
Cobbles	3 in. to 12 in.	Grapefruit
Coarse Gravel	¾-in. to 3 in.	Orange or lemon
Fine Gravel	No. 4 sieve to ¾-in.	Grape or pea
Coarse Sand	No. 10 sieve to No. 4 sieve	Rock salt
Medium Sand	No. 40 sieve to No. 10 sieve	Sugar, table salt
Fine Sand*	No. 200 sieve to No. 40 sieve	Powdered sugar
Fines	Less than No. 200 sieve	
*Particles finer than fine sand cannot be discerned with the naked eye at a distance of 8 inches.		

Coarse Grained Soil Sub Classification	Percent (by weight) of Total Sample
Terms: GRAVEL, SAND, COBBLES, BOULDERS	PRIMARY CONSTITUENT
Sandy, gravelly, abundant cobbles, abundant boulders	>30-50]
with gravel, with sand, with cobbles, with boulders	>15-30] – secondary coarse grained constituents
scattered gravel, scattered sand, scattered cobbles, scattered boulders	5-15]
a trace gravel, a trace sand, a few cobbles, a few boulders	<5]
Silty (MH & ML)*, clayey (CL & CH)*	<15]
(with silt, with clay)*	5-15] – secondary fine grained constituents
(trace silt, trace clay)*	<5]
*Index tests and/or plasticity tests are performed to determine whether the term "silt" or "clay" is used.	

*Modified after Ref. ASTM D2487-93 & D2488-93
**Modified after Ref. Oregon DOT 1987 & FHWA 1997
***Modified after Ref. AASHTO 1988, DM 7.1 1982, and Oregon DOT 1987

GENERAL NOTES

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD)

Description of Rock Quality	*RQD (%)
Very Poor	< 25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	90-100

*RQD is defined as the total length of sound core pieces 4 in. or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

SCALE OF RELATIVE ROCK HARDNESS

Term	Field Identification	Approx. Unconfined Compressive Strength (tsf)
Extremely Soft	Can be indented by thumbnail	2.6-10
Very Soft	Can be peeled by pocket knife	10-50
Soft	Can be peeled with difficulty by pocket knife	50-260
Medium Hard	Can be grooved 2 mm deep by firm pressure of knife	260-520
Moderately Hard	Requires one hammer blow to fracture	520-1040
Hard	Can be scratched with knife or pick only with difficulty	1040-2610
Very Hard	Cannot be scratched by knife or sharp pick	>2610

DEGREE OF WEATHERING

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

GRAIN SIZE (TYPICALLY FOR SEDIMENTARY ROCKS)

Description	Diameter (mm)	Field Identification
Very Coarse Grained	>4.76	Individual grains can easily be distinguished by eye.
Coarse Grained	2.0-4.76	
Medium Grained	0.42-2.0	Individual grains can be distinguished by eye.
Fine Grained	0.074-0.42	Individual grains can be distinguished by eye with difficulty.
Very Fine Grained	<0.074	Individual grains cannot be distinguished by unaided eye.

VOIDS

Pit	Voids barely seen with the naked eye to 6mm *1/4-inch)
Vug	Voids 6 to 50mm (1/4 to 2 inches) in diameter
Cavity	50 to 6000mm (2 to 24 inches) in diameter
Cave	> 600mm

BEDDING THCKNESS

Very Thick Bedded	> 3' Thick
Thick Bedded	1' to 3' Thick
Medium Bedded	4" to 1' Thick
Thin Bedded	1-1/4" to 4" Thick
Very Thin Bedded	½" to 1-1/4" Thick
Thickly Laminated	1/8" to ½" Thick
Thinly Laminated	1/8" or less (paper thin)

DRILLING NOTES

Drilling & Sampling Symbols

NQ – Rock Core (2-inch diameter)	CFA- Continuous Flight (Solid Stem) Auger	WB – Wash Bore or Mud Rotary
HQ – Rock Core (3-inch diameter)	SS – Split Spoon Sampler	TP – Test Pit
HSA – Hollow Stem Auger	ST – Shelby Tube	HA – Hand Auger

Soil Sample Types

Shelby Tube Samples: Relatively undisturbed soil samples were obtained from the borings using thin wall (Shelby) tube samplers pushed hydraulically into the soil in advance of drilling. This sampling, which is considered to be undisturbed, was performed in accordance with the requirements of ASTM D 1587. This type of sample is considered best for the testing of "in-situ" soil properties such as natural density and strength characteristics. The use of this sampling method is basically restricted to soil containing little to no chert fragments and to softer shale deposits.

Split Spoon Samples: The Standard Penetration Test is conducted in conjunction with the split-barrel sampling procedure. The "N" value corresponds to the number of blows required to drive the last 1 foot of an 18-inch long, 2-inch O.D. split-barrel sampler with a 140 lb. hammer falling a distance of 30 inches. The Standard Penetration Test is carried out according to ASTM D-1586.

Water Level Measurements

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, shallow groundwater may indicate a perched condition. Caution is merited when interpreting short-term water level readings from open bore holes. Accurate water levels are best determined from piezometers.

Automatic Hammer

Palmerton and Parrish, Inc.'s CME's are equipped with automatic hammers. The conventional method used to obtain disturbed soil samples used a safety hammer operated by company personnel with a cat head and rope. However, use of an automatic hammer allows a greater mechanical efficiency to be achieved in the field while performing a Standard Penetration resistance test based upon automatic hammer efficiencies calibrated using dynamic testing techniques.

*Modified after Ref. ASTM D2487-93 & D2488-93
**Modified after Ref. Oregon DOT 1987 & FHWA 1997
***Modified after Ref. AASHTO 1988, DM 7.1 1982, and Oregon DOT 1987

APPENDIX IV – IMPORTANT INFORMATION REGARDING YOUR GEOTECHNICAL REPORT

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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in 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.

Geotechnical-Engineering 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 given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives 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 this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- 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. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering 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 subsurface environmental problems have led to project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GBA
GEOPROFESSIONAL
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ASSOCIATION

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