



April 27, 2023

Smart Realty, LLC  
144 W. Broadway  
Waukesha, WI 53186

Attn: Mr. David L. R. Smart  
Owner

Re: Preliminary Geotechnical Exploration and Site Feasibility Evaluation  
Proposed Meadowbrook Single Family Residential Development  
NWC of Meadowbrook Rd and Summit Ave  
Waukesha, WI  
PSI Project No: 00523178

Dear Mr. Smart:

The preliminary subsurface exploration and evaluation for the above referenced project has been completed. An electronic copy of the report is being provided via email. Hard copies can be issued upon request. After you have had the opportunity of reading the report, please call at any time with any questions or comments you may have. Professional Service Industries, Inc. (PSI), an Intertek Company, appreciates the opportunity to be of service on this project and looks forward to continuing as your geotechnical consultant during the design and construction phases, as well as your upcoming projects.

Sincerely,

**PROFESSIONAL SERVICE INDUSTRIES, INC.**

Emily M. Broback  
Project Manager

Patrick J. Patterson, P.E., P.G.  
Senior Engineer  
Environmental Services

James M. Becco, P.E.  
Regional Vice President  
Geotechnical Services



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PSI • 821 Corporate Court • Waukesha, Wisconsin 53186 • 262-521-2125 • Fax 262-521-2471 • www.psiusa.com

**PRELIMINARY GEOTECHNICAL EXPLORATION AND  
EVALUATION**

For the:

Proposed Meadowbrook Single Family  
Residential Development  
NWC Meadowbrook Rd and Summit Ave  
Waukesha, WI 53188

Prepared for:

Smart Realty, LLC  
144 W. Broadway  
Waukesha, WI 53586

Prepared by:

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PSI Project No: 00523178

April 27, 2023



A handwritten signature in black ink, appearing to read "Emily Broback".

Emily M. Broback  
Project Manager

A handwritten signature in black ink, appearing to read "Patrick J. Patterson".

Patrick J. Patterson, P.E., P.G.  
Senior Engineer  
Environmental Services

A handwritten signature in black ink, appearing to read "James M. Becco".

James M. Becco, P.E.  
Regional Vice President  
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## **INTRODUCTION**

### General

This report presents the results of the preliminary subsurface exploration and site feasibility evaluation for the Proposed Meadowbrook Single Family Residential Development located on the northwest corner of Meadowbrook Road and Summit Avenue in the City of Waukesha, Wisconsin. The work was performed for Smart Realty, LLC at the request of Mr. David Smart.

### Purpose

The purpose of this preliminary study was to evaluate the subsurface conditions at specific boring locations on the site, and to provide subsurface information for general site feasibility and preliminary design planning. A comprehensive foundation evaluation and recommendations for specific structures were beyond the scope of this preliminary site evaluation but are recommended as part of design planning.

### Scope

The scope of services included a site reconnaissance, the subsurface exploration, a determination of soil characteristics by field and laboratory testing, and an evaluation of the data obtained. The scope of the field exploration program, including the number, depth, and location of the borings was determined by the client, in conjunction with PSI.

### Authorization

The description of services and authorization to perform this subsurface exploration and foundation evaluation were in the form of a signed PSI Proposal No. 395754, dated March 23, 2023. The general conditions for the performance of the work were referenced in the proposal. This report has been prepared on behalf of, and exclusively for the use of Smart Realty, LLC. The information contained in this report may not be relied upon by any other parties without the express written consent of PSI, and acceptance by such parties of PSI's General Conditions.

## **SITE AND PROJECT DESCRIPTION**

### Site Features

The project site is located to the northwest corner of Meadowbrook Road and Summit Avenue, approximately 1250 feet northwest of the intersection, in Waukesha, Wisconsin. At the time of exploration, the site was a vacant lot with wooded areas throughout. Portions of the site have previously been utilized as agricultural fields. The surrounding properties consist of agricultural fields to the north, residential properties to the west and south, and a

church and rehabilitation hospital to the east. A review of aerial photos on Google Earth indicates that the site has remained relatively similar to that described herein since at least September of 2008 when construction of the rehabilitation hospital was completed.

The topography of the general site is rolling, generally sloping down to the south and east with an elevation difference between the borings of about 103 feet (El. 198± to EL. 95±).

### Project Description

Based on information provided by the client, it is understood that the proposed project will consist of multiple one to two-story single-family residential buildings with basements; associated roadways; utilities; and stormwater management areas.

Structural loads were not provided for the proposed buildings but are estimated to be light to moderate in magnitude. For the purpose of this report, it is estimated that maximum column and wall loads will not exceed 100 kips and 10 kips per lineal foot respectively. When structural loads are determined, PSI must be informed in order to determine if revisions to this report are necessary.

A grading plan and finished floor elevations for the proposed structures was not provided; however, based upon the topography map provided to PSI, and the grades of the surrounding neighboring properties, it is estimated that substantial cuts and fills of several feet or more (possibly in excess of 10 to 20 feet or even more) may be necessary at this site. The location of the buildings or other structure details were not provided, nor were planned elevations or final surface grades. When a grading plan is available, and when finished floor elevations, utility inverts, stormwater basins, and roadway grades have been established, PSI must be informed so that any necessary reevaluation or redirection of the recommendations included herein can be made.

Actual traffic loading for pavements has not been provided. However, it is understood that traffic will generally consist of light passenger vehicle traffic, delivery trucks, garbage trucks, school buses, and snow removal vehicles.

This preliminary exploration has been commissioned to evaluate the subsurface conditions across areas of the subject site and to provide subsurface information for general site feasibility and preliminary design planning for the proposed development. The number and spacing of the borings requested is not considered sufficient to serve as a conventional foundation evaluation for the proposed buildings. Additional borings are necessary and recommended within each of the proposed building footprints to further evaluate more specific soil conditions and provide subsequent recommendations at each building location. Additional borings are also recommended to assist in establishing finished floor, yard, utility invert, and basement slab elevations. When additional project information becomes available, PSI must be provided an opportunity to review them and determine if a redirection of the evaluation and recommendations contained herein is warranted.

## EXPLORATION AND LABORATORY PROCEDURES

### Scope Summary

The field and laboratory data utilized in the evaluation of the subsurface materials was obtained by drilling exploratory test borings, securing soil samples by the split-spoon sampling method, and subjecting the samples to laboratory testing.

With respect to the stormwater management area, the field and laboratory work for classification of the subgrade soils was performed to provide information for use by the basin design personnel when considering requirements of Chapter NR151 of the Wisconsin Administrative Code, and of WDNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration" guidelines. The design of the proposed stormwater management area was beyond the scope of services for this project.

### Field Exploration

Fifteen (15) soil test borings were performed for this project. Eleven (11) borings (B-1 through B-11) were performed in the planned lots and pavement areas to depths of 20 to 25 feet below the existing grade. B-5 was planned to be drilled to a depth of 25 feet but was terminated at a depth of about 22 feet below existing grade due to auger refusal on possible cobbles, boulders, or bedrock. Four (4) borings (B-12 through B-15) were performed in the proposed stormwater management area to depths of about 15 to 25 feet below existing grade. The number, depth, and approximate location of the soil borings were selected by the client in consultation with PSI. The borings were located in the field by the drill crew utilizing a handheld consumer grade GPS device. They are considered to be accurate within several feet. The approximate locations of the borings performed are shown on the Boring Location Plan (Figure 1), which is provided in the Appendix of this report. The elevations on the boring logs were estimated by interpolation of a one-foot contour map of the property, provided by the client. The elevations are estimated to be accurate to within about 1 foot.

The soil test borings were performed with an all-terrain (ATV) mounted rotary drilling rig utilizing continuous flight hollow stem augers to advance the holes. Representative samples were obtained by the Standard Penetration Test (SPT) method using split-spoon sampling procedures in general accordance with ASTM D-1586 procedures. Samples were collected at 2.5-foot intervals to 10 feet, and then at 5-foot intervals thereafter to the end of the borings. *As an exception, samples were obtained at 2 foot intervals at the borings performed within the proposed pavement and/or stormwater management areas.* The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty (30) inches, required to advance the split-spoon sampler one (1) foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The SPT provides a means of estimating the relative density of granular soils

and comparative consistency of cohesive soils, thereby providing a method of evaluating the relative strength and compressibility characteristics of the subsoils.

The SPT soil samples were transferred into clean glass jars immediately after retrieval and returned to the laboratory upon completion of the field operations. Samples will be discarded unless other instructions are received. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D- 2488-75) or the USDA Textural Soil Classification systems. A description of the subsurface conditions encountered at each boring location is shown on the enclosed Soil Boring Logs. After completion of the borings, the auger holes were backfilled to the ground surface with bentonite chips.

A copy of the Soil Boring Logs and Boring Location Plan (Figure 1) are enclosed in the Appendix. The soil stratification shown on the logs represents the approximate soil conditions in the actual boring locations at the time of the exploration. The terms and symbols used on the logs are described in the General Notes found in the Appendix.

#### Laboratory Physical Testing

Soil samples obtained from this exploration were visually classified in the laboratory, and subjected to testing, which included moisture content determinations. Selected cohesive soil samples were tested in unconfined compression with an uncontrolled strain loading rate and/or with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The values of strength tests performed on soil samples obtained by the Standard Penetration Test Method (SPT) are considered approximate, recognizing that the SPT method provides a representative but somewhat disturbed soil sample. The laboratory testing was performed in general accordance with the respective ASTM methods, as applicable, and the results are shown on the boring logs in the Appendix.

## **DESCRIPTION OF SUBSURFACE CONDITIONS**

### General

A description of the subsurface conditions encountered at the test boring locations is shown on the Soil Boring Logs. The lines of demarcation shown on the logs represent approximate boundaries between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole locations, but that variations may occur between and beyond the sampling intervals and boring locations. Soil depths, topsoil and layer thicknesses, and demarcation lines utilized for preconstruction planning should not be expected to yield exact and final quantities. A summary of the major soil profile components is described in the following paragraphs.

## Soil Conditions

### *Lot and Pavement Borings (B-1 through B-11) USCS Classification*

Surficial materials encountered at most of the borings consisted of about 4 to 10 inches of topsoil comprised of dark brown sandy and lean clay. There was no discernible topsoil observed at B-7. Below the surficial materials were natural soils generally consisting predominately of light brown to gray sand and gravel, with occasional silt and clay layer extending to the termination depths of about 20 to 25 feet (EL. 96 to EL. 178) below existing grade. B-5 was terminated at 22 feet (EL. 15) due to auger refusal on possible cobbles, boulders, or bedrock. The cohesive soils were stiff to very stiff in consistency, with estimated unconfined compressive strengths of about 1.5 to 2.5 tons per square foot (tsf). The natural granular soils were in a loose to extremely dense condition with N-values ranging from 7 blows per foot (bpf) to 50 blows per 2 inches.

### *Stormwater Management Area Borings (B-12 through B-15) - USDA Classification*

The surficial soils encountered in the stormwater management borings generally consisted of 8 to 10.5 inches of dark brown silty clay loam topsoil. The topsoil was underlain by dark brown to very pale brown gravelly to very gravelly sand loam, silt loam, gravelly to very gravelly fine to medium sand, and silty clay loam to the termination depth of 15 to 25 feet (EL. 68 to EL. 74) below grade.

The foregoing discussion of soil conditions on this site represents a generalized soil profile as determined at the test boring locations. A more detailed description and supporting data for each test location can be found on the individual Soil Boring Logs and Soil Evaluation - Storm Forms enclosed in the Appendix.

## Groundwater Observations

Groundwater observations were made during the drilling operations, and in the open boreholes upon completion. Groundwater was encountered within B-1, B-5, B-7, and B-8 at depths ranging from about 3 to 8 feet (EL. 153 to EL. 172.5) during auger advancement. Upon completion and removal of the augers, groundwater was observed within B-7 at a depth of about 9.5 feet (EL. 168.5) below existing grade. No groundwater was observed within the remaining borings during drill operations or upon completion of drilling and removal of the augers.

The groundwater observations reported herein are considered approximate. It must be recognized that groundwater levels fluctuate with time due to variations in seasonal precipitation, lateral drainage conditions, and soil permeability characteristics. Longer term monitoring would be required to further evaluate groundwater levels on this site.

## **EVALUATION AND RECOMMENDATIONS**

### General Development Considerations

In view of the subsurface conditions encountered in the test borings, together with the structural loading criteria and development grades anticipated, conventional spread footings, along with conventional slab-on-grade construction, can be used for support of the proposed structures. However, difficulty with groundwater and softening of subgrade soils may be experienced where excavations encroach upon or extend below the anticipated groundwater level, especially within basement excavation work. An adequate dewatering effort, possibly in conjunction with the overexcavation of unstable zones, and the use of a crushed stone working mat, may be required. Additionally, it is recommended that basement slabs be placed at least 2 feet above the groundwater level.

Auger refusal on cobbles, boulders or possible bedrock was encountered at B-5 at a depth of about 22 feet (EL. 150) below existing grade. In addition, dense to extremely dense soils were encountered with increasing depth in several of the borings. Substantial difficulty digging and longer excavation times will likely be experienced in some areas. Additionally, the use of ripping with dozers (in lieu of scrapers) may be necessary during cutting.

Conventional asphalt pavement can be used in the pavement areas. A discussion of the building foundation and pavement design parameters, as well as the support conditions for the floor slab and pavement are included in later sections.

The number, depth, and spacing of the borings performed for this preliminary study is not considered sufficient to serve as a conventional foundation evaluation for specific structures. Therefore, additional borings (and possibly test pits) within the footprints of the proposed structures, and in utility areas are recommended and considered essential to further evaluate the subsurface conditions, groundwater levels, and the depth and extent of dense to extremely dense soils (including the refusal materials) in order to assist with establishing surface grade and resulting basement slab elevations. It must be recognized that the conditions encountered by the additional explorations may warrant an alteration of the preliminary foundation and soil bearing design recommendations presented in this report. A discussion of preliminary guidelines and recommendations is included in the following sections.

### Site Preparation

The presence of organic topsoil, and vegetation in the subgrade can adversely affect the serviceability of structural fills, foundations, floor slabs, pavements, and other structures placed upon them. Approximately 4 to 10 inches of topsoil were present on the surface of the site at most of the boring locations. However, some variation should be expected, especially within agricultural fields, where tilling and other related operations can result in thicker pockets of topsoil, or topsoil having become intermixed within underlying soils. All topsoil, vegetation, trees, roots and other organic matter must be stripped from the areas

of footings, floor slabs, pavements, sidewalks, and other structures.

Portions of the property were previously utilized as farm fields. If any remnant drain tiles are encountered during construction, it is generally recommended that they be tied into new drainage structures or otherwise be properly drained to a suitable area (in accordance with any applicable regulatory requirements or restrictions), since they may still actively drain areas of the subject site or adjacent properties.

After stripping the topsoil and cutting high areas of the site to the planned finished grade, and prior to the placement of new fill which may be placed to raise grades, the subgrade must be thoroughly proofrolled to detect unstable, yielding soils. This should consist of overlapping passes in a perpendicular grid pattern, with a fully-loaded tandem-axle dump truck, or other equipment of similar size and weight suitable for the surface conditions. Proofrolling should be performed in consultation with the geotechnical engineer at the time of construction. Some difficulty with subgrade preparation may be experienced, especially in wet or cold weather, or during thawing conditions. Additionally, instability can become more severe in silty and clayey materials, which are considered to be moderately to highly moisture sensitive. It is generally recommended that earthwork be carried out during relatively warm, dry weather. Any soft, wet, or otherwise unstable zones which cannot be improved by scarification and aeration, must be removed and replaced with compacted structural fill, such as clean crushed stone, possibly in conjunction with the use of a geotextile fabric. Construction delays and difficulty with subgrade stabilization may be experienced during periods of wet and/or cool weather.

Every effort must be made to keep excavations dry. If construction proceeds during wet weather, some additional overexcavation may be necessary. If weather permits, the soil could be dried and recompacted. A crushed stone working mat, possibly in conjunction with a geotextile fabric may also be feasible to help stabilize subgrades. Site grading runoff should be directed to catch basins, so that the potential for the softening of the foundation and pavement subgrade soils is reduced.

Where the removal of unsuitable bearing material is performed beneath proposed footings, the excavation must extend laterally beyond the perimeter of the foundation for a distance at least equal to the thickness of the fill below the footing bottom. This general guideline also applies to instances where a raised structural fill pad is constructed to achieve a bearing elevation greater than existing grades. The influence zone of footing stresses can be represented as an imaginary 45° line extending downward and outward from the footing bottom. All fill placed within this zone after cutting to firm soil must be properly engineered, from the bottom of the cut, up to the floor slab subgrade elevation.

If site grades are raised in excess of 2 feet, the first lift of new fill must be placed so as to extend a minimum lateral distance of 5 feet beyond the planned top building pad dimension (for fills less than 5 feet in thickness), or for a distance equal to at least 1 foot laterally beyond the top pad dimension for every foot of fill thickness (for fills greater than 5 feet in depth). Subsequent lifts can then be placed on an approximate 1H:1V slope back

up to the planned top perimeter dimension of the pad. Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities.

When a firm and stable subgrade is established, low areas may be raised to planned grades with properly compacted structural fill. Any new fill should be a clean granular soil, such as those materials meeting the gradations outlined in Section 209 or 305 of the State of Wisconsin Standard Specification for Highway and Structure Construction. If fine-grained soils, such as those with high silt or clay content are used, they should generally be placed over large open areas, where conditions are more favorable for the proper placement and compaction of such materials. It must be recognized that high silt or clay content materials are difficult to compact when placed at moisture contents beyond a few percent of the optimum moisture content. Fill must be placed in layers of not more than nine (9) inches in thickness, at moisture contents at or near optimum, and be compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM designation D-698. Silt, clay, and wet granular soils are not suitable for reuse as compacted fill in trenches, or adjacent to foundation stem walls or retaining walls.

Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. This is especially true of clayey soils, where scarification and aeration may be required to achieve near - optimum moisture levels prior to compaction. A sheepsfoot roller is generally required for compaction of clayey soils, whereas a vibratory smooth drum roller is preferred for granular material. Small hand-operated compactors should be used in confined areas; granular fills are generally more readily compacted to the required densities in such applications.

It is recommended that well-graded granular soils be utilized as backfill in new utility trenches and alongside below grade walls to reduce the potential for consolidation and settlement of the fill. All fill soils must be placed and compacted under engineering controlled conditions, to provide suitable support for overlaying structures and roadways. Additional guidance can be provided at the time of construction in the selection process for grade-raising fill and trench backfill.

The selection of fill materials for various applications should be done in consultation with the soils engineer. Similarly, the evaluation of the subgrade and placement and compaction of fill for structural applications should be monitored and tested by a qualified representative of the soils engineer.

### Preliminary Foundation Evaluation

The following is a general overview of the subsurface conditions for the site, as it relates to foundation analysis, and can be used in preliminary site planning.

For preliminary planning, spread and continuous wall footings bearing upon suitable on-site natural soils encountered within the borings, or structural fill (or lean concrete mix) used to replace unsuitable materials, can generally be designed to exert net allowable soil bearing pressures of 2,000 to 4,000 psf, dependent upon location and bearing

elevation. However, some undercutting of soft, loose, wet, or otherwise unsuitable natural soils may be required. All foundations must bear upon suitable and stable soils of sufficient strength. A more comprehensive exploration, consisting of additional borings is recommended to further evaluate allowable bearing pressures within each structure.

The suitability of the existing soils for support of the proposed foundation must be determined by testing by a qualified geotechnical engineer during construction, utilizing static cone penetrometer tests or dynamic cone penetrometer tests for cohesive and granular soils, respectively. Soft, loose, or otherwise unsuitable materials not disclosed by the borings, may be encountered in the foundation excavations at the bearing elevation, especially in unexplored areas of the site. If unsuitable existing soil is present, it must be removed throughout a zone extending one foot laterally for each foot removed below the foundation, on either side of the planned footing. The over-excavated area must be backfilled with structural compacted fill. As an alternate, the excavation could extend 4 inches beyond the plan footing width to suitable bearing soil and then backfilled with lean (500 to 1000 psi) concrete mix to planned footing grade to reduce lateral over-excavation.

All perimeter footings must be placed at a depth of 4 feet (or lower if required by local code or in accordance with customary practice) below the finish grade for frost protection. Due to periodic severity of winters in this area, it is recommended that footings in poorly heated or unheated areas of the building also be placed at least 4 feet below the adjacent exterior grade. Interior footings not subject to frost action may be placed at a shallow depth of 18 inches below the floor slab, provided they bear on suitable natural soils or engineered fills. All footings must be protected from the effects of frost if construction is carried out during winter months.

It is recommended that the footings supporting individual columns have a minimum dimension of 24 inches, and continuous footings have a minimum width of 18 inches, even if the maximum recommended allowable bearing pressure is not fully utilized. In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils and any variations in seasonal moisture contents, it is recommended that all footings be suitably reinforced to make them as rigid as needed.

In general, the performance of the foundation systems on this site is dependent on the various factors discussed herein. The excavation, preparation, and concreting of foundations should be monitored and tested by a representative of the soils engineer.

#### Preliminary Floor Slab and Pavement Subgrades

Prior to constructing the floor slabs or pavements, and prior to the placement of any fill used to raise grades, the exposed subgrade in near surface areas must be prepared utilizing the proofrolling procedures described previously. In slab and pavement areas that exhibit soft, yielding or unstable soil conditions, the following remedial measures are recommended to provide a stable subgrade. It is recommended that the proofrolling

operations be monitored by a representative of the geotechnical engineer so that a firm, suitable subgrade is present prior to placement of new fills, or to construction of floor slabs and pavements.

Localized wet, soft or unstable areas can be undercut to such depths determined necessary in the field to reach stable material, and the area backfilled with imported crushed stone, such as the 1¼-inch gradation specified in Section 305 of the WisDOT Standard Specifications, placed and compacted as recommended in the Site Preparation section of this report. If relatively thick zones or areas of extensive yielding are observed, and they cannot be stabilized by normal discing, aeration and recompaction procedures, undercutting and replacement with crushed stone and geotextile fabric (if needed) may also be required in these areas.

The floor slab(s) may be designed utilizing an estimated modulus of subgrade reaction of 175 pci based on the presence of a suitable and stable subgrade, prepared as discussed in this report. However, this is based on common range values obtained from 1 ft. x 1 ft. plate load tests on specific soil types. Depending on how the slab load is applied, the value may need to be modified for larger areas using the following:

Modulus of Subgrade Reaction       $k_s = \left(\frac{k}{B}\right)$  for cohesive soil

$k_s = k \left(\frac{B+1}{2B}\right)^2$  for cohesionless soil

where:  $k_s$  = coefficient of vertical subgrade reaction for loaded area  
 $k$  = coefficient of vertical subgrade reaction for a 1x1 foot square area  
 $B$  = width of area loaded, in feet

The final design and detailing should be performed by a qualified structural engineer based on the intended slab use, loading conditions and anticipated subgrade conditions.

A granular mat, which can be designed as a drainage layer, should be provided below the floor slab. This must be a minimum of 6 inches in thickness and properly compacted. In moisture sensitive areas, a vapor retarder may be placed beneath the floor slab or base course; however, it is recommended that the architect be consulted in this regard. The proper use of a vapor retarder may not completely prevent moisture beneath or on top of slabs. If the base course contains sharp particles, a cushion layer of sand approximately 2 inches in thickness may be required to provide protection from puncture.

The floor slab must be suitably reinforced to make it as rigid as necessary and proper joints provided at the junction of slabs and the foundation system so that a small amount of independent movement can occur without causing damage. Large floor areas must be provided with joints at frequent intervals (maximum spacing of 30 times the slab thickness, per ACI) to compensate for concrete volume changes (shrinkage). Where the slab will be supporting live loads, such as from moving vehicles, joints must be keyed or dowelled to permit proper load transfer. It is recommended that appropriate construction

methods and curing procedures be used to minimize shrinkage and curling of the floor slabs.

### Exterior/Unheated Area Slabs

Entry slabs, sidewalks, aprons, and other slabs in exterior or unheated areas may bear upon generally sandy soils. Such materials are not considered to be highly frost susceptible. However, it must be noted that slabs placed directly upon more frost susceptible soils, such as those with high silt or clay content (occasional silt and clay layers were encountered in the borings), are subject to heaving and subsequent settlement due to freeze/thaw cycles. This can result in cracking, misalignment, and other related effects (especially at joints). If more fine grained soils are encountered in areas beyond the borings, or are used to raise grades, it is recommended that consideration be given to limited undercutting of frost susceptible materials, where encountered, to a depth of 1 to 2 feet below the slab, and replacement with well graded, properly placed and compacted granular soils. A properly designed underdrain system connected to the municipal sewer (if permissible) or directed to on-site stormwater management areas should also be incorporated to reduce the potential effects of freeze/thaw cycles.

### Utility Construction

In general, the on-site soils can be used for support of utility lines. However, some undercutting of softened soils, in conjunction with the placement of crushed stone or other suitable granular backfill may be necessary to establish a stable working mat and/or bearing subgrade. Some difficulty with the stability of utility trenches should be expected due to the presence of granular soils across the site, especially in the presence of water. The use of shoring, bracing, or trench boxes will be required. Additionally, excavations encroaching upon or extending below the groundwater within granular soils can become substantially unstable when the confining effect of the overburden is removed. An adequate dewatering effort and bracing of sidewalls will be required. Utility construction should be performed in accordance with "The Standard Specifications for Sewer and Water Line Construction" for the State of Wisconsin.

It is recommended that well graded granular soils such as those specified in Tables 37 and 39 of the Standard Specification for Sewer and Water Construction be utilized as backfill in utility trenches to reduce the potential for consolidation and settlement of the backfill. All fill soils must be properly placed and compacted under engineering-controlled conditions to provide suitable support for overlaying structures and roadways. Silty and clayey soils, organic soils, and wet materials are not recommended for use as backfill within utility trenches due to the substantial difficulty of obtaining proper compaction in confined areas. Substantial importing of suitable fill will likely be required.

As with all excavation work, all open cut trenches must be properly shored and braced as required by applicable federal and state OSHA codes, and as necessary to protect life and property.

### Below Grade Basement Walls

Groundwater was encountered within B-1, B-5, B-7, and B-8 at depths ranging from about 3 to 8 feet (EL. 153 to EL. 172.5) during auger advancement. Upon completion and removal of the augers, groundwater was observed within B-7 at a depth of about 9.5 feet (EL. 168.5) below existing grade. It is recommended that basement slabs be placed at least 2 feet above the groundwater. Further evaluation of groundwater levels is necessary and imperative in order to assist in developing final surface grades and floor elevations so that basement slab elevations remain a sufficient distance above the groundwater.

It is recommended that an underdrain system and drainage course be placed beneath the floor slab and alongside the basement walls (if conventional construction is used) to alleviate hydrostatic uplift pressure beneath the slab and excessive lateral pressure on the walls. The drain system should be connected to adequate sumps for drainage and be properly discharged in accordance with all state and local discharge requirements. Drain tile should have a minimum diameter of four (4) inches and should be wrapped with an appropriate filter fabric. Drainage pipes should be surrounded by clean gravel and extend up to the near ground surface in window well areas. At least six (6) inches of clean  $\frac{3}{4}$  inch stone should be utilized for the free draining layer beneath the floor areas.

The below grade walls must be backfilled for a lateral distance of 3 to 4 feet with a well-graded, free draining granular material. This should be placed in lifts not exceeding 12 inches in thickness and be compacted to at least 95 percent of the Standard Proctor density. Based upon the use of a clean, crushed stone fill, and a fully drained condition, an equivalent fluid pressure of 65 psf may be used as the horizontal component of earth pressure at rest. However, when a proposed fill material has been selected, a representative sample must be submitted to PSI for testing to verify the above values and associated recommendations. Silt and clay soils, organic soils, and wet granular materials are not suitable for use as backfill alongside basement walls. It must be recognized that the above value is based upon a drained condition and is exclusive of traffic and other surcharge loads near the walls, which must be factored into the design.

## **CONSTRUCTION CONSIDERATIONS**

### Groundwater Control

Groundwater observations made during drilling activities and upon completion of drilling and the removal of the augers. Groundwater was encountered within B-1, B-5, B-7, and B-8 at depths ranging from about 3 to 8 feet (EL. 153 to EL. 172.5) below existing grade, during auger advancement. Upon completion and removal of the augers, groundwater was observed within B-7 at a depth of about 9.5 feet (EL. 168.5) below existing grade. No groundwater was observed within the remaining borings during auger advancement or upon completion of drilling and removal of the augers.

On the basis of the observations, some difficulty with groundwater may be experienced

during excavation work in at least some areas on this site, especially where deeper cuts are performed during grading, and within basement, stormwater basin and deeper utility excavations. If excavations extend only a few inches or so below the groundwater or low volume perched zones, a filtered sump pump or other conventional means may suffice to control the groundwater. However, for deeper excavations, or for large volume perched zones, prolonged dewatering with a series of sumps, or other more comprehensive means may be necessary to facilitate construction.

It must be recognized that groundwater levels fluctuate with time due to variations in seasonal precipitation, lateral drainage conditions, and soil permeability characteristics. Longer term monitoring would be required to further evaluate groundwater levels on this site.

Since the foundation materials are subject to softening when exposed to free moisture, every effort should be made to keep excavations dry. Discharge water from roof drains should be directed away from the building, and the site grading direct runoff to catch basins, so that the potential for the softening of the foundation and pavement subgrade soils is reduced.

#### Excavations and Site Drainage

Sloping, shoring or bracing of the excavation sidewalls will be necessary. Excavating may be difficult, especially in granular soils, due to the instability of vertical slopes, and will therefore require a flattening of trench sides, or some other means of protection, to facilitate construction and to protect life and property. Substantial sloughing and caving should be expected within unprotected excavations. The degree of excavation instability problems is dependent upon the depth and length of time that excavations remain open, excavation bank slopes, water levels and the effectiveness of any dewatering systems. However, severe instability may occur within granular or soft clay soils. All excavation work must be performed in accordance with OSHA and local building code requirements.

Auger refusal on cobbles, boulders, or possible bedrock was encountered at a depth of about 22 feet (EL. 150) below existing grade at B-5, and dense to extremely dense soils were encountered with increasing depth in several of the borings. Substantial difficulty digging and longer excavation times will likely be experienced in some areas. Additionally, the use of ripping with dozers (in lieu of scrapers) may be necessary during cutting. Additional borings (and possibly test pits) are recommended to further evaluate the dense to extremely dense soils and refusal materials (and groundwater levels) in order to assist with establishing surface grade and resulting basement slab elevations.

Where excavations encroach upon or extend below the groundwater or perched zones and into sand, silt, or soft clay, a substantially unstable subgrade may develop when the confining effect of the overburden is removed. Significant sloughing or caving of sidewalls may also occur. Some overexcavation of softened or loosened soils, in conjunction with the use of a crushed stone working mat, may be necessary to establish a stable bearing

subgrade. Additionally, significantly widened excavations may result, or be required to maintain or achieve sidewall stability. Extreme difficulty with excavations and in achieving a stable subgrade may be experienced on this site, especially when encroaching upon or extending below the groundwater.

It is mandated that excavations, whether they be for utility trenches, or footing excavations, be constructed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines to protect workers and others during construction. PSI recommends that these regulations be strictly enforced; otherwise, workers could be in danger and the owner(s) and the contractor(s) could be liable for substantial penalties. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

Since the subgrade soils are generally sensitive to moisture, every effort should be made to provide adequate drainage across the site during construction, and to prevent ponding of runoff on the subgrade. These soils are also subject to erosion caused by runoff, and erosion control measures should be implemented where needed or required by local ordinances.

### Seismic Design Considerations

The soils encountered in the borings are considered to meet the criteria for Site Class D in accordance with 1613.2.5.2 of the International Building Code-2018 (which directs to the simplified design procedure outlined in ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures).

## **PRELIMINARY PAVEMENT RECOMMENDATIONS**

The subgrade soils encountered at the borings consisted of predominately sand, with occasional silt, and clay layers. The sand soils have been assigned an estimated visual classification of A-2-4 by the AASHTO soil classification method. These soils are generally rated as fair for pavement subgrade support due to their low frost susceptibility, fair drainage characteristics, and lower susceptibility to strength loss when exposed to free water. The silt and clay soils have been assigned an estimated visual classification of A-4 and A-6, respectively, by the AASHTO soil classification method. These soils are generally rated as poor for pavement subgrade support due to their moderate to high frost

susceptibility, poor drainage characteristics, and higher susceptibility to strength loss when exposed to free water.

Evaluation of the visual soils classification and laboratory testing has been made in estimating pertinent engineering properties of the subgrade soils, as described in the “Wisconsin Soils Manual for Pavement Section Design.” Based on the engineering properties determined from the subgrade soils tested, and with proper subgrade preparation, the following pavement subgrade design coefficients are recommended for pavement section thickness evaluation for this project. Any fill used to raise grades or replace unsuitable subgrade materials must be a granular material with limited fines, such as is specified in Section 209 or Section 305 of the WisDOT Standard Specification.

<b>PAVEMENT SUBGRADE DESIGN COEFFICIENTS</b>		
	<b>GRANULAR</b>	<b>CLAY</b>
AASHTO Soil Classification	<b>A-2-4</b>	<b>A-4/A-6</b>
Design Frost Index	<b>F-3</b>	<b>F-3</b>
Design Group Index	<b>10</b>	<b>14</b>
Soil Support Value	<b>4.3</b>	<b>3.5</b>
Estimated Subgrade Modulus (k)	<b>200 pci</b>	<b>125 pci</b>

During construction, the surficial subgrade soils can become wet, softened and disturbed. Therefore, prior to placing fill materials and base course, the subgrade must be recompacted and proofrolled. Particular attention should be given to high traffic areas that have become rutted and areas of backfilled trenches. Localized wet, soft, or unstable areas can be undercut to such depths determined necessary in the field to reach stable materials, and the area backfilled with crushed stone, such as 1¼ or 3-inch traffic bond (Section 305 of the State of Wisconsin Standard Specification for Highway and Structure Construction). If relatively large or thick zones of extensive yielding are observed, and normal discing and recompaction procedures cannot stabilize them, undercutting and replacement with crushed stone and geotextile fabric (if needed) may also be required in these areas. Preparation of the pavement subgrade must be performed as outlined in the Pavement Subgrade Preparation section of this report.

Periodic pavement maintenance is required to keep a pavement, under normal traffic and environmental conditions, as near as possible to its constructed condition. Maintenance is necessary to reduce the effects of pavement stress caused by changes in temperature and moisture, repetitive traffic loadings, and movement of the subgrade soils. As pavement distress is observed, it should be repaired as quickly as possible. Unrepaired areas will generally lead to more severe and widespread distress, and eventually, pavement disintegration. Therefore, periodic maintenance consisting of crack sealing, seal coating every 3 to 5 years, and other necessary repairs at least annually, will be required to obtain the design service life.

The subject site is located in an area that experiences annual freezing cycles. The sandy subgrade soils encountered at most of the borings are not generally considered to be highly susceptible to frost action. However, near surface layers of finer grained soils

(which are highly moisture sensitive) were present in several of the borings, and may be encountered in other areas. In addition, it is generally good customary practice to control surface runoff in order to reduce the potential for frost action. It is recommended that underdrains be placed within the subgrade, just below the granular base, to help reduce the potential for trapping water within the aggregate base layer. Sufficient drain tiles extending radially outward an adequate distance from each interior catch basin must be installed. In addition, drain tiles should extend along curb lines, up the slope from curb inlets. The drain tile should be directly connected to the storm sewer manholes or catch basins (if permissible by local municipal or other applicable code). The drain tile should consist of perforated PVC pipe of adequate diameter placed beneath the base layer, extending a sufficient distance into the subgrade. The pipe should be surrounded by appropriately sized clean stone, with the pipe and stone being wrapped with a geotextile filter fabric to reduce the potential for soils to migrating into and obstruct the pipe. It is also recommended that roof drains be connected to the stormwater collection system to minimize the potential for this water to enter the base and subgrade.

## **STORMWATER MANAGEMENT AREA CONSIDERATIONS**

As requested by the client, borings B-12 through B-15 were performed in the area of the proposed stormwater management areas. The subgrade soils encountered at these locations have been visually classified in general accordance with the USDA textural soil classification system. They generally consisted of gravelly to very gravelly sand loam, silt loam, gravelly to very gravelly fine to medium sand, and silty clay loam to the termination depth of 15 to 25 feet (EL. 68 and EL. 74) below existing grade. No groundwater was encountered during auger advancement or upon completion and removal of the augers.

With regard to the above soil and groundwater conditions encountered at the borings, NR 151.124(4)(c)1 and 2 – *Infiltration rate exemptions* indicates that infiltration practices located in an area where the infiltration rate of the soil encountered in the area of the infiltration system is less than 0.6 inches per hour using a scientifically credible field test method; or an area where the least permeable soil horizon to 5 feet below the proposed bottom of the infiltration system using the USDA method of soils analysis consists of silty clay, silty clay loam, clay loam and sandy clay loam may be credited toward meeting the requirements, but the decision to infiltrate under these conditions is optional. In addition, NR 151.124(4)(b)1 – *Separation distances* indicates that infiltration practices shall be located so that the characteristics of the soil and the separation distance between the bottom of the infiltration system and the elevation of seasonal high groundwater or the top of bedrock are in accordance with the following Table (reproduced from NR 151.124):

<b>Table 3. Separation Distances and Soil Characteristics</b>		
<b>Source Area</b>	<b>Separation Distance</b>	<b>Soil Characteristics</b>
Industrial, Commercial, Institutional Parking Lots and Roads	5 feet or more	Filtering Layer*
Residential Arterial Roads	5 feet or more	Filtering Layer*
Roofs Draining to Surface Infiltration Practices	1 foot or more	Native or Engineered Soil with Particles Finer than Coarse Sand
Roofs Draining to Surface Infiltration Practices	Not Applicable	
All Other Impervious Source Areas	3 feet or more	Filtering Layer*

\*Defined in NR 151.002(14r) as a “soil that has at least a 3-foot deep layer with at least 20 percent fines; or at least a 5-foot deep layer with at least 10 percent fines; or an engineered soil with an equivalent level of protection as determined by the regulatory authority for the site.”

The information shown above is a selected excerpt from NR151 that is intended only as general guidance for considering stormwater management in conjunction with the encountered subsurface conditions at the borings. Basin design must be performed by a qualified and experienced firm. In addition, the entirety of Chapter NR151 of the Wisconsin Administrative Code, the Site Evaluation for Stormwater Infiltration (1002) document, and other applicable references; along with appropriate state, local or other municipal requirements must be consulted as part of site-specific stormwater design.

Stormwater management basins are not recommended to be placed in close proximity to basements or other below grade walls and structures. Proper and careful consideration of soils and subsurface conditions must be given during site and design planning, and extreme care must be exercised during construction. Lateral migration of water may result in substantially increased sump pump activity and can quickly overcome the ability of such pumps to maintain a desirable water level, resulting in significant flooding. The potential for such conditions to occur can greatly increase when basement floors are below the elevation of basin bottoms and/or when basins are placed in close proximity to structures (strongly not recommended). In addition, the presence of granular or other generally permeable soils, which is typically necessary in the areas of structures for utility backfill, alongside basement walls, or within other development excavations/trenches can act as extensive migration channels to rapidly carry large volumes of water from basins and into nearby basements. Building codes or municipal regulations may require that basement floor elevations be a specified distance above the water level of nearby basins or other stormwater features. It is therefore recommended that the design engineer (or other appropriate representative) review applicable municipal or other regulatory

requirements and verify the design normal and design high water elevations of stormwater basins/features with respect to planned basement slab elevations.

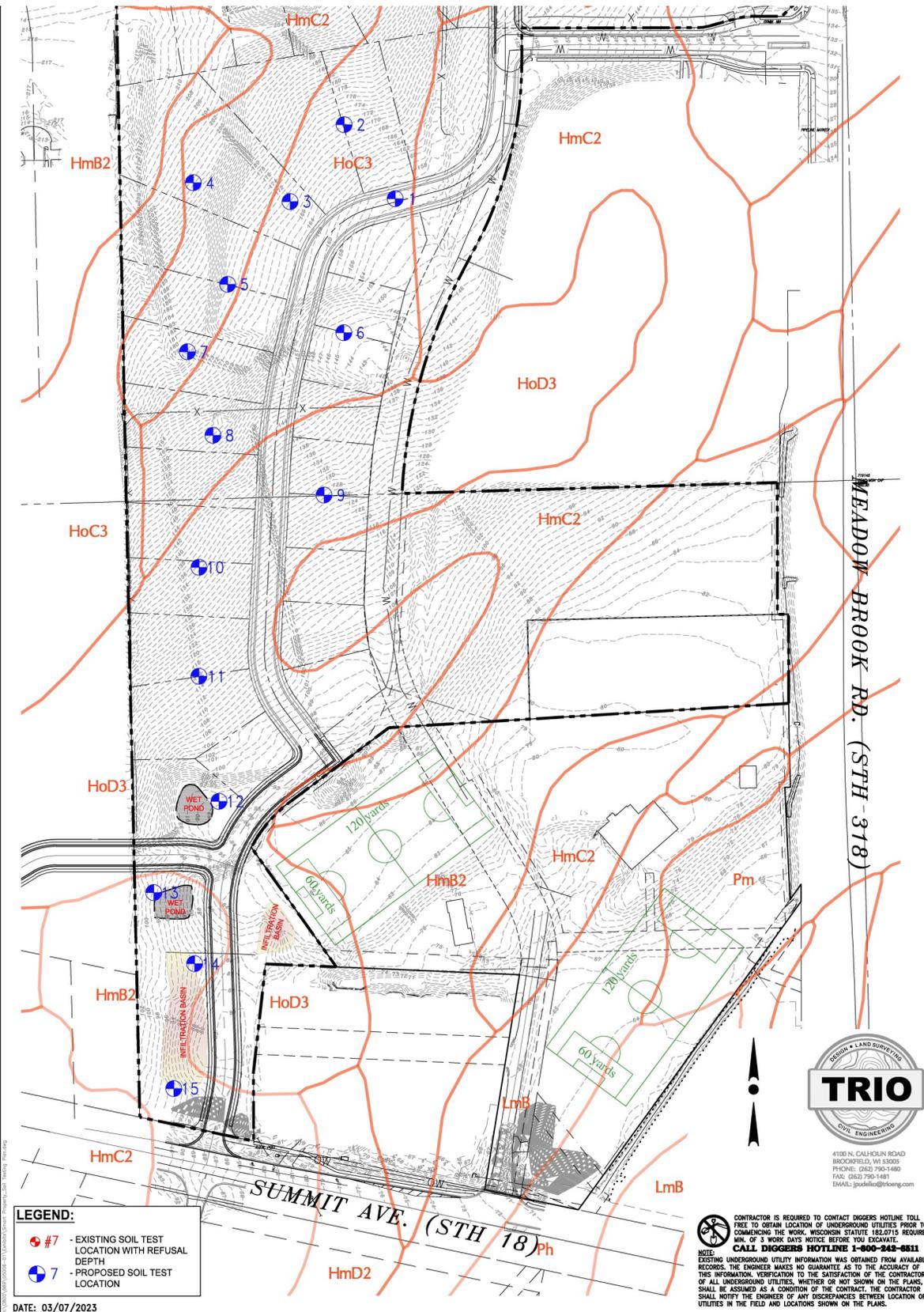
## **GENERAL COMMENTS**

This geotechnical exploration and foundation analysis has been prepared to aid in the evaluation of the foundation conditions on this site. The recommendations presented herein are based on the available soil information and the design information provided. Any changes in the design information or building locations should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations expressed or implied, and no warranty or guarantee is included or intended in this report.

It is recommended that the earthwork and foundation operations be monitored by the soils engineer, to test and evaluate the bearing capacities, and the selection, placement and compaction of controlled fills.

**APPENDIX**  
**BORING LOCATION PLAN**  
**BORING LOGS**  
**GENERAL NOTES**  
**Soil Evaluation Form-Storm**  
**USDA Notes**



**LEGEND:**

- #7 - EXISTING SOIL TEST LOCATION WITH REFUSAL DEPTH
- 7 - PROPOSED SOIL TEST LOCATION

DATE: 03/07/2023



**NOTE:** CONTRACTOR IS REQUIRED TO CONTACT DIGGERS HOTLINE TOLL FREE TO OBTAIN LOCATION OF UNDERGROUND UTILITIES PRIOR TO COMMENCING THE WORK. WISCONSIN STATUTE 182.0715 REQUIRES MIN. OF 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE. **CALL DIGGERS HOTLINE 1-800-248-8811**  
 EXISTING UNDERGROUND UTILITY INFORMATION WAS OBTAINED FROM AVAILABLE RECORDS. THE ENGINEER MAKES NO GUARANTEE AS TO THE ACCURACY OF THIS INFORMATION. VERIFICATION TO THE SATISFACTION OF THE CONTRACTOR OF ALL UNDERGROUND UTILITIES, WHETHER OR NOT SHOWN ON THE PLANS, SHALL BE ASSUMED AS A CONDITION OF THE CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES BETWEEN LOCATION OF UTILITIES IN THE FIELD AND LOCATIONS SHOWN ON THE PLANS.



Meadowbrook Residential Development  
 NWC of Meadowbrook Rd. and Summit Ave  
 Waukesha, WI

**BORING LOCATION PLAN**

SCALE: 1 inch = 200 feet (approx.)

DATE: 4/20/2022

PSI PROJECT NO. 00523178

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** PR **LOGGED BY:** AW  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** ASV D-50 ATV - Rig #420  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 156 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

# BORING B-1

**Water**  
 ∇ While Drilling 3 feet  
 ▼ Upon Completion Not Obsvd  
 ▽ Delay N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0	0	Topsoil, Dark Brown Sandy Clay, Trace Gravel, Moist (5"± Thick)					TPSL		20	×	
155	14	Brown Fine to Coarse Sand and Gravel, Moist to Wet		1	14			16-20-23 N=43	4	×	⊙
150	5			2	14		SP	20-12-11 N=23	7	×	⊙
145	10			3	3			13-5-13 N=18	7	×	⊙
140	15			4	14	Brown Silt With Sand and Gravel, Moist		20-34-35 N=69	6	×	>>⊙
135	16			5	16		ML	18-19-19 N=38	9	×	⊙
130	20			6	14			20-17-18 N=35	9	×	⊙
						End of Boring at 20'					
						Cave-In at 5.5'					



Professional Service Industries, Inc.  
 821 Corporate Court, Suite 100  
 Waukesha, WI 53189  
 Telephone: (262) 521-2125

**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** PR **LOGGED BY:** AW  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** ASV D-50 ATV - Rig #420  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 171 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** \_\_\_\_\_ **HAMMER TYPE:** Automatic  
**LONGITUDE:** \_\_\_\_\_ **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:** \_\_\_\_\_  
**REMARKS:** \_\_\_\_\_

## BORING B-2

<b>Water</b>	▽	While Drilling	Not Obsvd
	▼	Upon Completion	Not Obsvd
	▽	Delay	N/A

**BORING LOCATION:** \_\_\_\_\_

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⊙ X Moisture    ⊠ PL ⊕ LL	STRENGTH, tsf ▲ Qu    * Qp	Additional Remarks
170	0	(Topsoil)				Topsoil, Dark Brown Lean Clay, Trace Gravel, Moist (4"± Thick)	TPSL	46	46			X
168	2	(Light Brown Silt)		1	18	Light Brown Silt With Sand and Gravel, Moist		9-8-8 N=16	8	X	⊙	
165	5	(Brown Fine to Medium Sand)		2	12		ML	7-10-12 N=22	8	X	⊙	
163	7	(Gray Silt)		3	10			50/6"	6	X		>> ⊙
160	10	(Brown Fine to Medium Sand)		4	10	Brown Fine to Medium Sand and Gravel, Moist	SP	50/5"	7	X		>> ⊙
155	15	(Gray Silt)		5	14	Gray Silt With Sand and Gravel, Moist	ML	34-33-48 N=81	7	X		>> ⊙
150	20	(End of Boring)		6	9	End of Boring at 20' Cave-In at 13.5'		50/5"	6	X		>> ⊙



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**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** PR **LOGGED BY:** AW  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** ASV D-50 ATV - Rig #420  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 169 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

## BORING B-3

**Water**  
 ∇ While Drilling Not Obsvd  
 ▼ Upon Completion Not Obsvd  
 ▽ Delay N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	STANDARD PENETRATION TEST DATA				Additional Remarks	
									TEST DATA N in blows/ft ⊙		STRENGTH, tsf			
		Moisture, %		Moisture, %		Moisture, %		Moisture, %						
0		Topsoil, Brown Lean Clay, Very Moist (7"± Thick)		1	10		TPSL	33						
		Brown Silty Fine Sand and Gravel, Moist		2	16		SM	9-14-24 N=38	6	×		⊙		
		Brown to Gray Silt With Sand and Gravel, Moist		3	2		ML	17-23-24 N=47	6	×		⊙		
165	5			4	10			50/3"	5	×			>>⊙	
160	10			5	3			50/4"	5	×			>>⊙	
155	15			6	2			50/4"	4	×			>>⊙	
150	20							50/3"	6	×			>>⊙	
		End of Boring at 20'												
		Cave-In at 12.5'												



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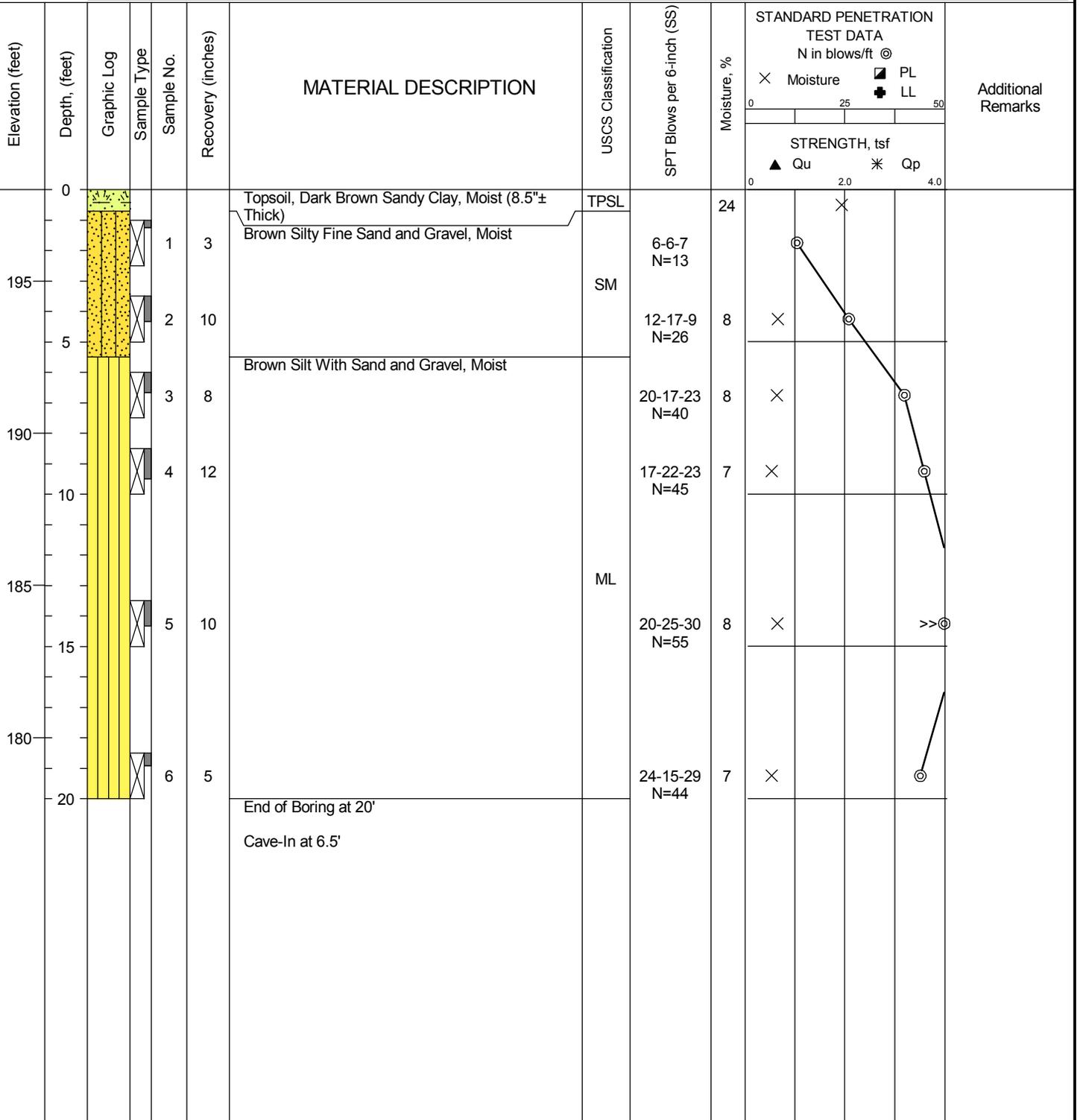
**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/12/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/12/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 198 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

## BORING B-4

**Water**  
 ∇ While Drilling Not Obsvd  
 ▼ Upon Completion Not Obsvd  
 ▽ Delay N/A

**BORING LOCATION:**



Professional Service Industries, Inc.  
 821 Corporate Court, Suite 100  
 Waukesha, WI 53189  
 Telephone: (262) 521-2125

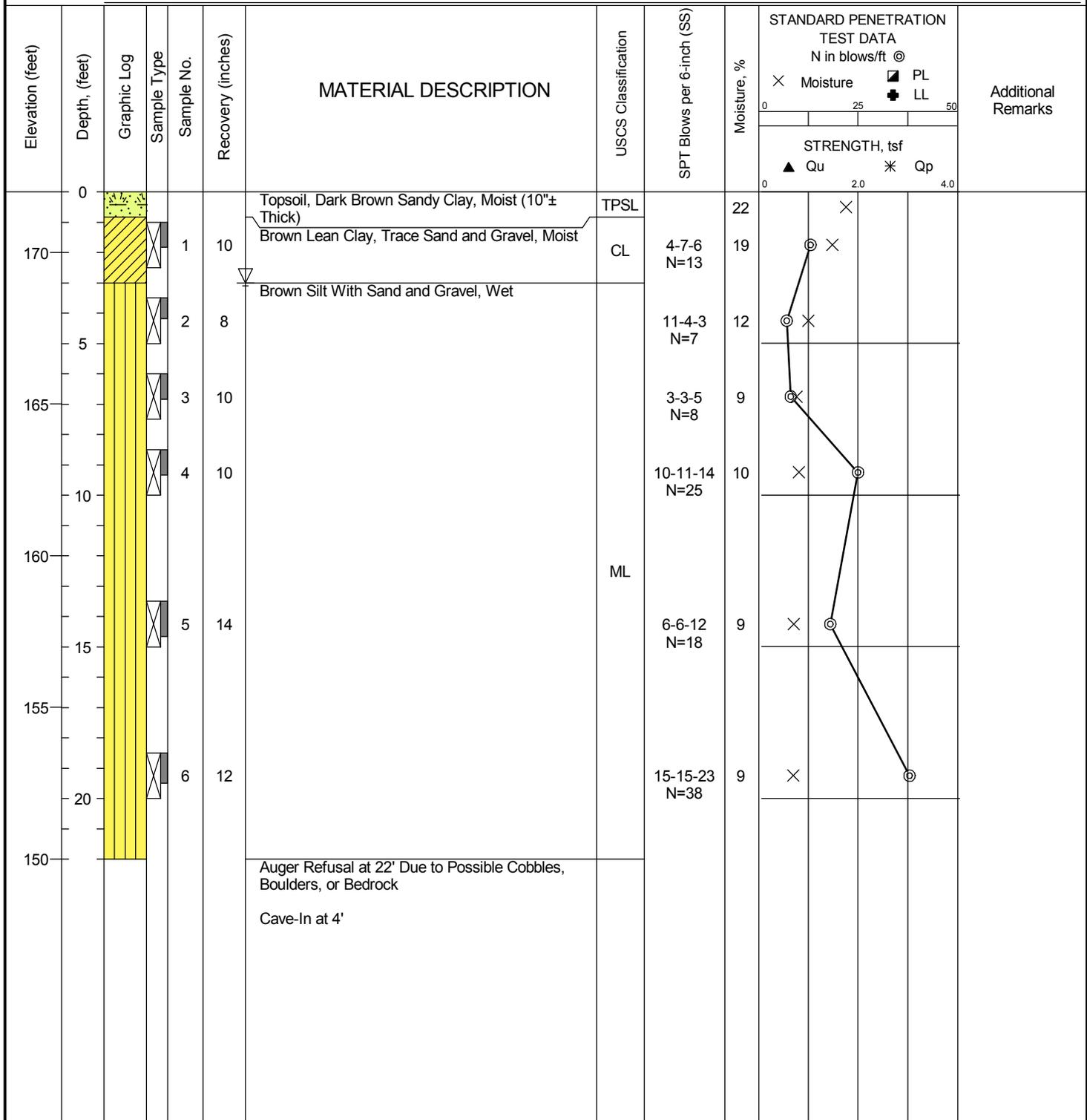
**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/12/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/12/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 22.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 172 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-5**

<b>Water</b>	▽ While Drilling	3 feet
	▼ Upon Completion	Not Obsvd
	▽ Delay	N/A

**BORING LOCATION:**



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** PR **LOGGED BY:** AW  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** ASV D-50 ATV - Rig #420  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 145 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** \_\_\_\_\_ **HAMMER TYPE:** Automatic  
**LONGITUDE:** \_\_\_\_\_ **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:** \_\_\_\_\_  
**REMARKS:** \_\_\_\_\_

## BORING B-6

<b>Water</b>	▽	While Drilling	Not Obsvd
	▼	Upon Completion	Not Obsvd
	▽	Delay	N/A

**BORING LOCATION:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⊙ × Moisture    ⊠ PL ⊕ LL	STRENGTH, tsf ▲ Qu    * Qp	Additional Remarks
0		Topsoil, Dark Brown Lean Clay, Very Moist (7"± Thick)					TPSL	34		×		
		Brown Silt With Sand and Gravel, Moist		1	16		ML	15-17-17 N=34	8	×	⊙	
140	5			2	16	27-22-18 N=40		8	×		⊙	
				3	14	79/12"		6	×			>>⊙
135	10			4	9	50/4"		5	×			>>⊙
130	15			5	7	50/2"		7	×			>>⊙
125	20			6	10	95/7"		7	×			>>⊙
						End of Boring at 20' Cave-In at 12'						



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** PR **LOGGED BY:** AW  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** ASV D-50 ATV - Rig #420  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 178 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-7**

<b>Water</b>	▽ While Drilling	5.5 feet
	▼ Upon Completion	9.5 feet
	▽ Delay	N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0	0	Brown Medium Sand and Gravel, Moist NO DISCERNIBLE TOPSOIL	[Symbol]	1	8		SP	7-16-26 N=42	8	STANDARD PENETRATION TEST DATA N in blows/ft ⊙ × Moisture    ◻ PL ◼ LL STRENGTH, tsf ▲ Qu            * Qp	
175	5			2	8			48-20-15 N=35	8		
170	10	Brown Silt With Sand and Gravel, Wet to Moist	[Symbol]	3	6		ML	20-12-11 N=23	5		
165	15			4	16			13-17-15 N=32	7		
160	20	End of Boring at 20' Cave-In at 11.5'	[Symbol]	5	4		ML	50/5"	6	>> ⊙	
155	20			6	7			50/2"	6		



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/12/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/12/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 25.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 157 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

# BORING B-8

**Water**  
 ∇ While Drilling 8 feet  
 ▼ Upon Completion Not Obsvd  
 ▽ Delay N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks	
0		Topsoil, Dark Brown Sandy Clay, Moist (10"± Thick)					TPSL					
155	6	Brown Silt With Sand and Gravel, Clay Pockets, Moist		1	6		ML	3-10-11 N=21	23			
5	8	Brown Silt With Sand and Gravel, Very Moist		2	8		ML	3-4-9 N=13	10			
150	10	Brown Silty Medium Sand and Gravel, Wet		3	10		ML	19-28-36 N=64	6		>>⊕	
145	10			4	8		SM	9-10-22 N=32	11			
140	15			5	10		SM	14-25-12 N=37	13			
135	20			6	7		SM	16-24-30 N=54	12		>>⊕	
25	25			7	8		SM	50/6"	11		>>⊕	
		End of Boring at 25'										
		Cave-In at 5'										



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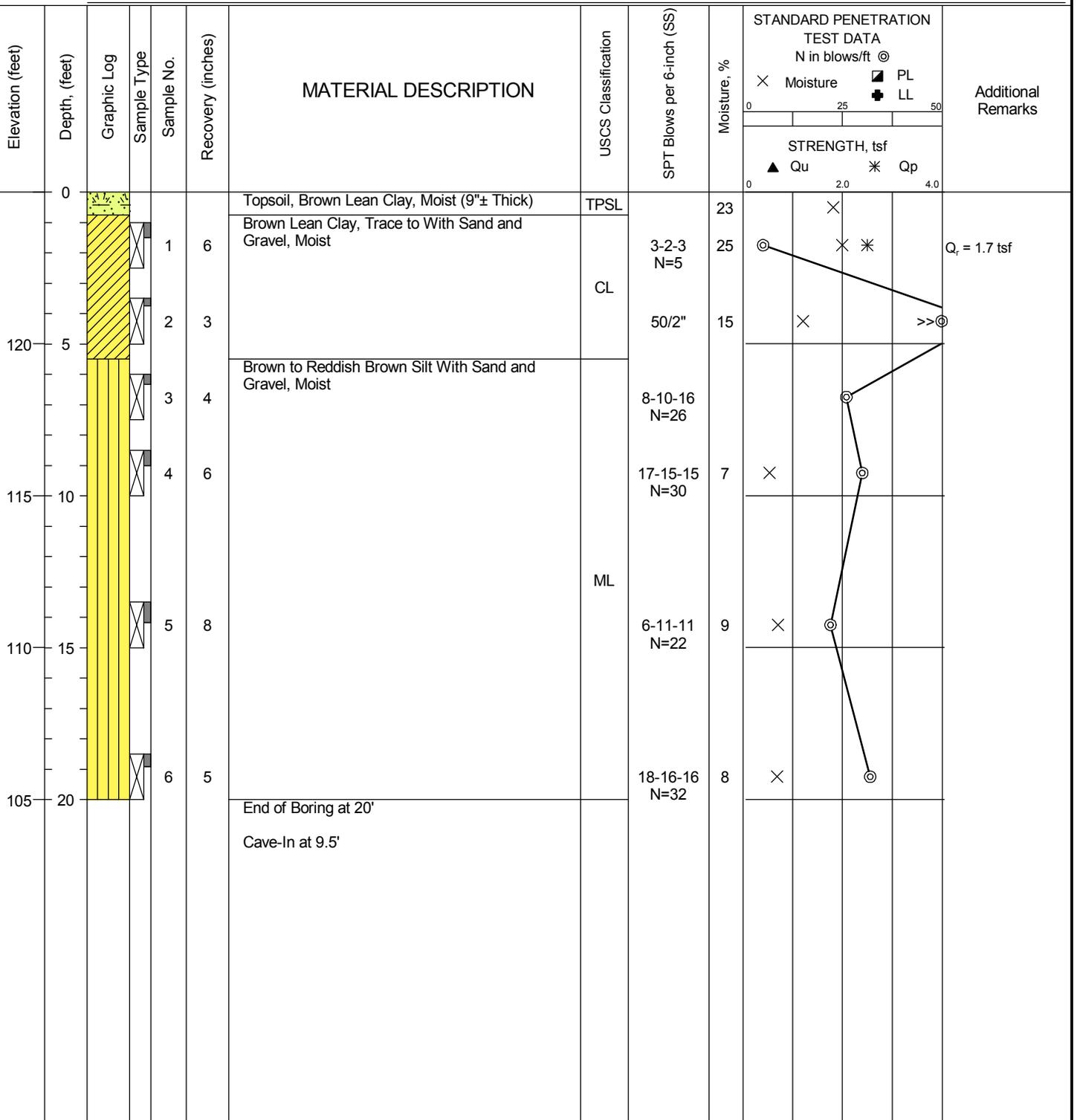
**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/12/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/12/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 125 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

## BORING B-9

**Water**  
 ∇ While Drilling Not Obsvd  
 ▼ Upon Completion Not Obsvd  
 ▽ Delay N/A

**BORING LOCATION:**



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

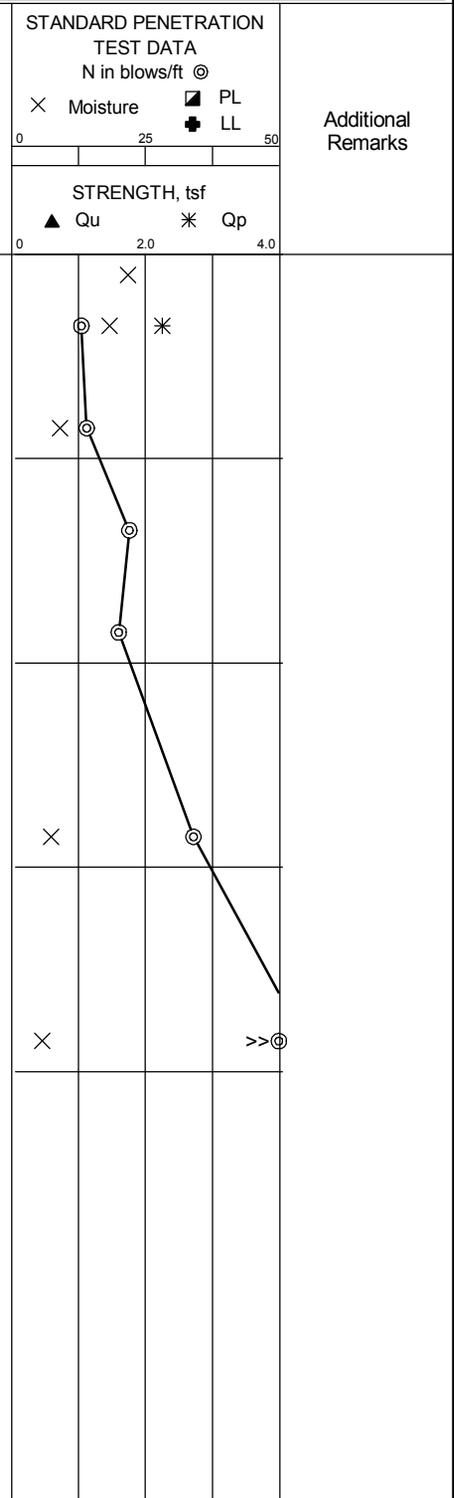
**DATE STARTED:** 4/12/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/12/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 135 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-10**

<b>Water</b>	▽	While Drilling	Not Obsvd
	▼	Upon Completion	Not Obsvd
	▽	Delay	N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0		[Topsoil]				Topsoil, Dark Brown Sandy Clay, Moist (9"± Thick)	TPSL				
		[Clay]		1	10	Brown Lean Clay, Trace Gravel, Moist	CL	5-6-7 N=13			
		[Silt]		2	8	Brown Silt With Sand and Gravel, Clay Pockets, Moist		8-7-7 N=14			
130	5	[Silt]		3	3		ML	4-8-14 N=22			
		[Silt]		4	5			11-14-6 N=20			
125	10	[Sand]		5	8	Brown to Gray Silty Fine Sand and Gravel, Moist		7-19-15 N=34			
		[Sand]		6	13		SM	30-25-30 N=55			
120	15										
115	20					End of Boring at 20' Cave-In at 9'					



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 20.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 116 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-11**

<b>Water</b>	▽	While Drilling	Not Obsvd
	▼	Upon Completion	Not Obsvd
	▽	Delay	N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	STANDARD PENETRATION TEST DATA N in blows/ft @	Moisture, %	Strength, tsf	Additional Remarks
115	0	Topsoil, Dark Brown Lean Clay, Moist (9.5"± Thick)					TPSL					
	10	Brown Lean Clay, Moist		1			CL	3-2-3 N=5				
	5	Brown Silt With Sand and Gravel, Moist		2			ML	4-6-6 N=12				
110				3			ML	8-13-17 N=30				
	10			4			ML	16-12-10 N=22				
105		Brown Silt Medium Sand and Gravel, Moist		5			SM	15-23-24 N=47				
100	15			6			SM	12-20-30 N=50				
20	20			6		End of Boring at 20' Cave-In at 5'						



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Medowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 15.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 89 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

## BORING B-12

<b>Water</b>	▽	While Drilling	Not Obsvd
	▼	Upon Completion	Not Obsvd
	⏸	Delay	N/A

**BORING LOCATION:** \_\_\_\_\_

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
0						Topsoil, Dark Brown Silty Clay Loam, Moist (10"± Thick)			20	×	
				1	10	Yellowish Brown Very Gravelly Silt Loam, Moist	8-7-28-50/2"	N=35	7	×	⊙
85				2	8		9-20-11-11	N=31	7	×	⊙
5				3	12	Yellowish Brown Very Gravelly Sand Loam, Moist	11-11-13-17	N=24	7	×	⊙
				4	12		6-9-9-13	N=18	6	×	⊙
80				5	14		10-15-20-18	N=35	7	×	⊙
10				6	2		50/3"		4	×	>>⊙
75				7	2		50/4"				>>⊙
15						End of Boring at 15'					
						Cave-In at 4'					



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**PROJECT NO.:** 00523178  
**PROJECT:** Meadowbrook Single Family Development  
**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 25.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 99 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-13**

<b>Water</b>	▽ While Drilling	Not Obsvd
	▼ Upon Completion	Not Obsvd
	▽ Delay	N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA		Additional Remarks
										N in blows/ft @		
0						Topsoil, Dark Brown Silty Clay Loam, Moist (8"± Thick)						
				1	10	Brown Gravelly Loam, Moist		7-5-4-14 N=9				
95				2	8			16-14-11-18 N=25				
5				3	6	Light Brownish Gray Very Gravelly Fine Sand, Moist		26-26-76/12"				
				4	5			50/3"				>>⊙
90				5	2			50/3"				>>⊙
				6	12	Yellowish Brown Gravelly Sand Loam, Moist		43-16-12-14 N=28				
85				7	2			50/4"				>>⊙
15				8	2			50/2"				>>⊙
				9	10	Yellowish Brown Gravelly Fine Sand Loam, Moist		50/5"				>>⊙
80				10	16			12-15-10-22 N=25				
				11	10	Pale Brown Gravelly Fine Sand, Moist		20-19-22-21 N=41				
75				12	12			15-10-18-28 N=28				
25						End of Boring at 25'						
						Cave-In at 6'						



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**PROJECT NO.:** 00523178  
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**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

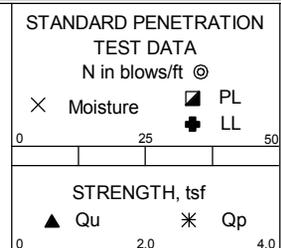
**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 25.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 93 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-14**

**Water**  
 ▽ While Drilling Not Obsvd  
 ▼ Upon Completion Not Obsvd  
 ▾ Delay N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0						Topsoil, Black Silty Clay Loam, Moist (8"± Thick)					
				1	10	Dark Brown Silty Clay Loam, Moist	4-3-3-6	19			
90				2	8	Yellowish Brown Very Gravelly Sand Loam, Moist	8-8-24-16	8			
5				3	12		12-16-11-12	8			
				4	12		21-15-17-13	4			
85				5	9	Brown Sand Loam, Moist	11-7-4-10	9			
10				6	2		4-9-15-12	24			
80				7	8	Brown Gravelly Sand, Moist	9-9-15-19	4			
15				8	10		25-13-12-15	4			
75				9	10		24-32-35-20	5			
20				10	14		16-16-15-20	5			
70				11	10		17-19-22-21	3			
25				12	16		15-20-18-30	3			
						End of Boring at 25'					
						Cave-In at 10.5'					



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**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

**DATE STARTED:** 4/11/23 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 4/11/23 **DRILLER:** DT **LOGGED BY:** ZM  
**COMPLETION DEPTH:** 25.0 ft **DRILL RIG:** Marooka D-50 ATV - Rig #395  
**BENCHMARK:** N/A **DRILLING METHOD:** Hollow Stem Auger  
**ELEVATION:** 95 ft **SAMPLING METHOD:** 2-in SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** N/A  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:**

**BORING B-15**

<b>Water</b>	▽ While Drilling	Not Obsvd
	▼ Upon Completion	Not Obsvd
	▽ Delay	N/A

**BORING LOCATION:**

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0						Topsoil, Dark Brown Silty Clay Loam, Very Moist (10.5"± Thick)					
				1	6	Dark Yellowish Brown Gravelly Sand Loam, Moist		6-6-6-15 N=12			
				2	4			6-16-16-13 N=32			
90	5			3	4			14-9-9-9 N=18			
				4	4			17-12-12-7 N=24			
				5	6	Dark Yellowish Brown Gravelly Sand, Moist		4-6-6-7 N=12			
85	10			6	12	Pale Brown Fine Sand, Moist		3-4-4-8 N=8			
				7	16			5-5-5-7 N=10			
80	15			8	10			8-9-9-14 N=18			
				9	10	Pale Brown Very Gravelly Fine to Medium Sand, Moist		11-10-10-13 N=20			
75	20			10	2			50/5"			
				11	5	Very Pale Brown Very Gravelly Fine Sand, Moist		50/4"			
				12	12			48-17-17-14 N=34			
70	25					End of Boring at 25' Cave-In at 6'					



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**PROJECT NO.:** 00523178  
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**LOCATION:** NEC of Summit Ave & Meadowbrook Rd  
 Waukesha, WI

## GENERAL NOTES

### SAMPLE IDENTIFICATION

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

### DRILLING AND SAMPLING SYMBOLS

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

### SOIL PROPERTY SYMBOLS

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

### RELATIVE DENSITY OF COARSE-GRAINED SOILS

<u>Relative Density</u>	<u>N - Blows/foot</u>
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

### ANGULARITY OF COARSE-GRAINED PARTICLES

<u>Description</u>	<u>Criteria</u>
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

### GRAIN-SIZE TERMINOLOGY

<u>Component</u>	<u>Size Range</u>
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

### PARTICLE SHAPE

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

### RELATIVE PROPORTIONS OF FINES

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

## GENERAL NOTES

(Continued)

### CONSISTENCY OF FINE-GRAINED SOILS

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

### MOISTURE CONDITION DESCRIPTION

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

### RELATIVE PROPORTIONS OF SAND AND GRAVEL

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

### STRUCTURE DESCRIPTION

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

### SCALE OF RELATIVE ROCK HARDNESS

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

### ROCK BEDDING THICKNESSES

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

### ROCK VOIDS

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

### GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

### ROCK QUALITY DESCRIPTION

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

### DEGREE OF WEATHERING

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

# SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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

### SOIL EVALUATION - STORM

In accordance with SPS 382.365 & 385, Wis. Adm. Code and WDNR Standard 1002

<p>Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.</p> <p style="text-align: center;"><b>Please print all information.</b></p> <p>Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04 (1) (m)].</p>	<p>County Waukesha</p> <p>Parcel I.D.</p> <p>Reviewed by:</p> <p>Date:</p>
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Property Owner	Property Location: Waukesha, WI		
	Govt. Lot		
Property Owner's Mailing Address	Lot #	Block #	Subd. Name or CSM#
City                  State                  Zip Code                  Phone Number	<input checked="" type="checkbox"/> City	<input type="checkbox"/> Village	<input type="checkbox"/> Town                  Nearest Road
	Waukesha		Meadowbrook Rd and Summit Ave

Drainage area _____ <input type="checkbox"/> sq. ft. <input type="checkbox"/> acres Optional: Test Site Suitable for (check all that apply) <input type="checkbox"/> Irrigation <input type="checkbox"/> Bioretention trench <input type="checkbox"/> Trench(es) <input type="checkbox"/> Rain Garden <input type="checkbox"/> Grassed swale <input type="checkbox"/> Reuse <input type="checkbox"/> Infiltration trench <input type="checkbox"/> SDS (> 15' wide) <input type="checkbox"/> Other _____	Hydraulic Application Test Method: <input checked="" type="checkbox"/> Morphological Evaluation <input type="checkbox"/> Double Ring Infiltrometer <input type="checkbox"/> Other (specify)	Soil Moisture Date of Borings: April 11, 2023 USDA-NRCS WETS Value:                  18 <input type="checkbox"/> Dry = 1; <input type="checkbox"/> Normal = 2; <input checked="" type="checkbox"/> Wet = 3.
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1	Obs. #	<input checked="" type="checkbox"/> Boring	B-12	Ground surface elevation ±	Elevation of limiting factor: >15'±											
		<input type="checkbox"/> Pit				Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
						1	0-10	10YR 3/3		sicl	1 f sbk	mfi		<15		0.04
						2	10-60	10YR 5/4		vygrsil	0 m	mfr		>35		0.13
						3	60-180	10YR 5/4		vygrsl	0 m	mfr		>35		0.5
Comment:																

2	Obs. #	<input checked="" type="checkbox"/> Boring	B-13	Ground surface elevation ±	Elevation of limiting factor: >25'±											
		<input type="checkbox"/> Pit				Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
						1	0-8	10YR 3/3		sicl	1 f sbk	mfi		<15		0.04
						2	8-60	10YR 4/3		grl	1 f sbk	mfr		>15		0.24
						3	60-132	10YR 6/2		vygrfs	0 sg	ml		>35		0.5
						4	132-204	10YR 5/4		grsl	1 f sbk	mfr		>15		0.5
						5	204-252	10YR 5/4		grfsl	0 m	mfr		>15		0.5
						6	252-300	10YR 6/3		grfs	0 sg	ml		>15		0.5
Comment:																

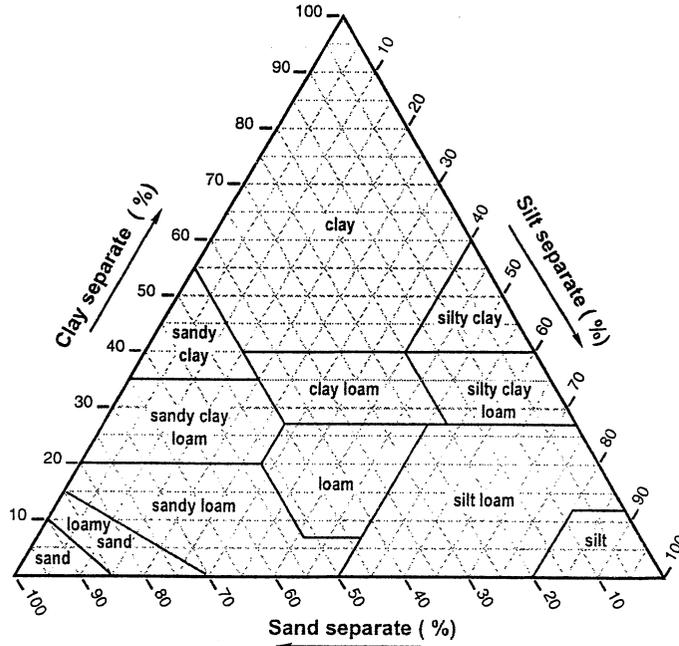
CST/PSS Name (Please Print) Patrick J. Patterson	Signature 	CST/PSS/Geologist Number G-229
Address 821 Corporate Court, Waukesha, WI 53189	Date Evaluation Conducted 4/11/2023	Telephone Number 262 521 2125

3	Obs. #	<input type="checkbox"/> Boring	B-14							
		<input checked="" type="checkbox"/> Pit	Ground surface elevation ±		Elevation of limiting factor: >25'±					
Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
1	0-8	10YR 2/1		sicl	1 f sbk	mfi		<15		0.04
2	8-36	10YR 3/3		sicl	1 thin pl	mfi		<15		0.04
3	36-108	10YR 5/4		vygrsl	0 m	mfr		>35		0.5
4	108-156	10YR 5/3		sl	0 m	mfr		<15		0.5
5	156-300	10YR 5/3		grs	0 sg	ml		<15		3.6
Comment:										

4	Obs. #	<input type="checkbox"/> Boring	B-15							
		<input checked="" type="checkbox"/> Pit	Ground surface elevation ±		Elevation of limiting factor: >25'±					
Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
1	0-10.5	10YR 3/3		sicl	1 f sbk	mfi		<15		0.04
2	10.5-108	10YR 4/6		grsl	0 m	mfr		>15		0.5
3	108-132	10YR 4/6		grs	0 sg	ml		>15		3.6
4	132-204	10YR 6/3		fs	0 m	mfr		<15		0.5
5	204-252	10YR 6/3		vygrf-ms	0 sg	ml		>35		3.6
6	252-300	10YR 7/3		vygrfs	0 sg	mfl		>35		0.5
Comment:										

### Texture Triangle:

Fine Earth Texture Classes ( ——— )



**TEXTURE MODIFIERS** - Conventions for using "Rock Fragment Texture Modifiers" and for using textural adjectives that convey the "% volume" ranges for Rock Fragments - Size and Quantity.

Fragment Content % By Volume	Rock Fragment Modifier Usage
< 15	No texture adjective is used (noun only; e.g., <i>loam</i> ).
15 to < 35	Use adjective for appropriate size; e.g., <i>gravelly</i> .
35 to < 60	Use "very" with the appropriate size adjective; e.g., <i>very gravelly</i> .
60 to < 90	Use "extremely" with the appropriate size adjective; e.g., <i>extremely gravelly</i> .
≥ 90	No adjective or modifier. If ≤ 10% fine earth, use the appropriate noun for the dominant size class; e.g., <i>gravel</i> . Use <b>Terms in Lieu of Texture</b> .

## ***(SOIL) TEXTURE***

This is the numerical proportion (percent by weight) of sand, silt, and clay in a soil. Sand, silt, and clay content is estimated in the field by hand (or quantitatively measured in the office/lab by hydrometer or pipette) and then placed within the texture triangle to determine **Texture Class**. Estimate the **Texture Class**; e.g., *sandy loam*; or **Subclass**; e.g., *fine sandy loam* of the fine earth ( $\leq 2$  mm) fraction, or choose a **Term in Lieu of Texture**; e.g., *gravel*. If appropriate, use a **Textural Class Modifier**; e.g., *gravelly silt loam*.

**NOTE:** Soil Texture encompasses only the fine earth fraction ( $\leq 2$  mm). **Particle Size Distribution (PSD)** encompasses the whole soil, including both the fine earth fraction ( $\leq 2$  mm; weight %) and rock fragments ( $> 2$  mm; volume %).

### **TEXTURE CLASS**

Texture Class or Subclass	Code	
	Conv.	NASIS
Coarse Sand	cos	COS
Sand	s	S
Fine Sand	fs	FS
Very Fine Sand	vfs	VFS
Loamy Coarse Sand	lcos	LCOS
Loamy Sand	ls	LS
Loamy Fine Sand	lfs	LFS
Loamy Very Fine Sand	lvfs	LVFS
Coarse Sandy Loam	cosl	COSL
Sandy Loam	sl	SL
Fine Sandy Loam	fsl	FSL
Very Fine Sandy Loam	vfsl	VFSL
Loam	l	L
Silt Loam	sil	SIL
Silt	si	SI
Sandy Clay Loam	scl	SCL
Clay Loam	cl	CL
Silty Clay Loam	sicl	SICL
Sandy Clay	sc	SC
Silty Clay	sic	SIC
Clay	c	C

TEXTURE MODIFIERS - (adjectives)

ROCK FRAGMENTS: Size & Quantity <sup>1</sup>	Code		Criteria: Percent (By Volume) of Total Rock Fragments and Dominated By (name size): <sup>1</sup>
	Conv.	PDP/ NASIS	
<b>ROCK FRAGMENTS (&gt; 2 mm; ≥ Strongly Cemented)</b>			
Gravelly	GR	GR	≥ 15% but < 35% gravel
Fine Gravelly	FGR	GRF	≥15% but < 35% fine gravel
Medium Gravelly	MGR	GRM	≥15% but < 35% med. gravel
Coarse Gravelly	CGR	GRC	≥ 15% but < 35% coarse gravel
Very Gravelly	VGR	GRV	≥ 35% but < 60% gravel
Extremely Gravelly	XGR	GRX	≥ 60% but < 90% gravel
Cobbly	CB	CB	≥ 15% but < 35% cobbles
Very Cobbly	VCB	CBV	≥ 35% but < 60% cobbles
Extremely Cobbly	XCB	CBX	≥ 60% but < 90% cobbles
Stony	ST	ST	≥ 15% but < 35% stones
Very Stony	VST	STV	≥ 35% but < 60% stones
Extremely Stony	XST	STX	≥ 60% but < 90% stones
Bouldery	BY	BY	≥ 15% but < 35% boulders
Very Bouldery	VBY	BYV	≥ 35% but < 60% boulders
Extremely Bouldery	XBY	BYX	≥ 60% but < 90% boulders
Channery	CN	CN	≥ 15% but < 35% channers
Very Channery	VCN	CNV	≥ 35% but < 60% channers
Extremely Channery	XCN	CNX	≥ 60% but < 90% channers
Flaggy	FL	FL	≥ 15% but < 35% flagstones
Very Flaggy	VFL	FLV	≥ 35% but < 60% flagstones
Extremely Flaggy	XFL	FLX	≥ 60% but < 90% flagstones
<b>PARAROCK FRAGMENTS (&gt; 2 mm; &lt; Strongly Cemented) <sup>2, 3</sup></b>			
Parabouldery	PBY	PBY	(same criteria as bouldery)
Very Parabouldery	VPBY	PBYV	(same criteria as very bouldery)
Extr. Parabouldery	XPBY	PBYX	(same criteria as ext. bouldery)
etc.	etc.	etc.	(same criteria as non-para)

<sup>1</sup> The "Quantity" modifier (e.g., *very*) is based on the total rock fragment content. The "Size" modifier (e.g., *cobbly*) is independently based on the largest, dominant fragment size. For a mixture of sizes (e.g., *gravel and stones*), a smaller size-class is named only if its quantity (%) sufficiently exceeds that of a larger size-class. For field texture determination, a smaller size-class must exceed 2 times the quantity (vol. %) of a larger size class before it is named (e.g., 30% gravel and 14% stones = *very gravelly*, but 20% gravel and 14% stones = *stony*). For more explicit naming criteria see NSSH-Part 618, Exhibit 618.11(Soil Survey Staff, 2001b).