Geotechnical Evaluation Report

Proposed STAR Center Facility
1319 and 1325 St. Andrew Street
La Crosse, Wisconsin

Prepared for

STAR Association

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Wisconsin.

Benjamin R. Sullivan, PE
Project Engineer
License Number: 46821
August 15, 2019

Project B1907847

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

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August 15, 2019 Project B1907847

Ms. Virginia Wintersteen
STAR Association
PO Box 1024
La Crosse, Wisconsin 54602

Re: Geotechnical Evaluation
Proposed STAR Center Facility
1319 and 1325 St. Andrew Street
La Crosse, Wisconsin

Dear Ms. Wintersteen:

We are pleased to present this Geotechnical Evaluation Report for the proposed STAR Center Facility to be located at 1319 and 1325 St. Andrew Street in La Crosse, Wisconsin.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Ben Sullivan or Brandon Wright at 608.781.7277 or by email at bsullivan@braunintertec.com or bwright@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Benjamin R. Sullivan, PE
Project Engineer

Brandon K. Wright, PE
Senior Engineer

AA/EOE

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BRAUN INTERTEC

A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and construction of the STAR Center Facility to be located at 1319 and 1325 St. Andrew Street in La Crosse, Wisconsin. The project will include construction of an approximate 63,435 square-foot, one- and two-story, structural-steel framed building with structural masonry walls and concrete floor slabs. Construction will also include pavements for parking lots as well as associated utilities and storm water improvements. Table 1 provides the project details.

Table 1. Project Description

Aspect	Description
Proposed STAR Center Facility	▪ One- and two-story, structural steel-framed building with structural masonry walls and concrete floor slabs. ▪ Construction will also include an in-ground swimming pool and therapy pool supported on pier foundations with structural floor slabs. ▪ We have assumed that column loads will be 350 kips or less, walls loads will be 25 kips per lineal foot or less, and interior floor slabs will support 100 pounds per square foot or less. ▪ According to I & S Group, Inc. the preliminary finished floor elevation is reported to be 648.0 with fills of less than 1-foot expected to achieve finished floor elevation.
Pavement and Assumed Traffic Loads	▪ Bituminous flexible pavements for the parking lot. ▪ Concrete rigid pavements for access drives. ▪ Light-duty parking areas: 50,000 ESALs* ▪ Heavy-duty drive lanes: 250,000 ESALs* ▪ Cuts and fills of 2 feet or less assumed.

*Equivalent 18,000-lb single axle loads based on 20-year design for bituminous pavements and 35-year for concrete pavements.

The figure below shows an illustration of the proposed site layout.

Figure 1. Site Layout

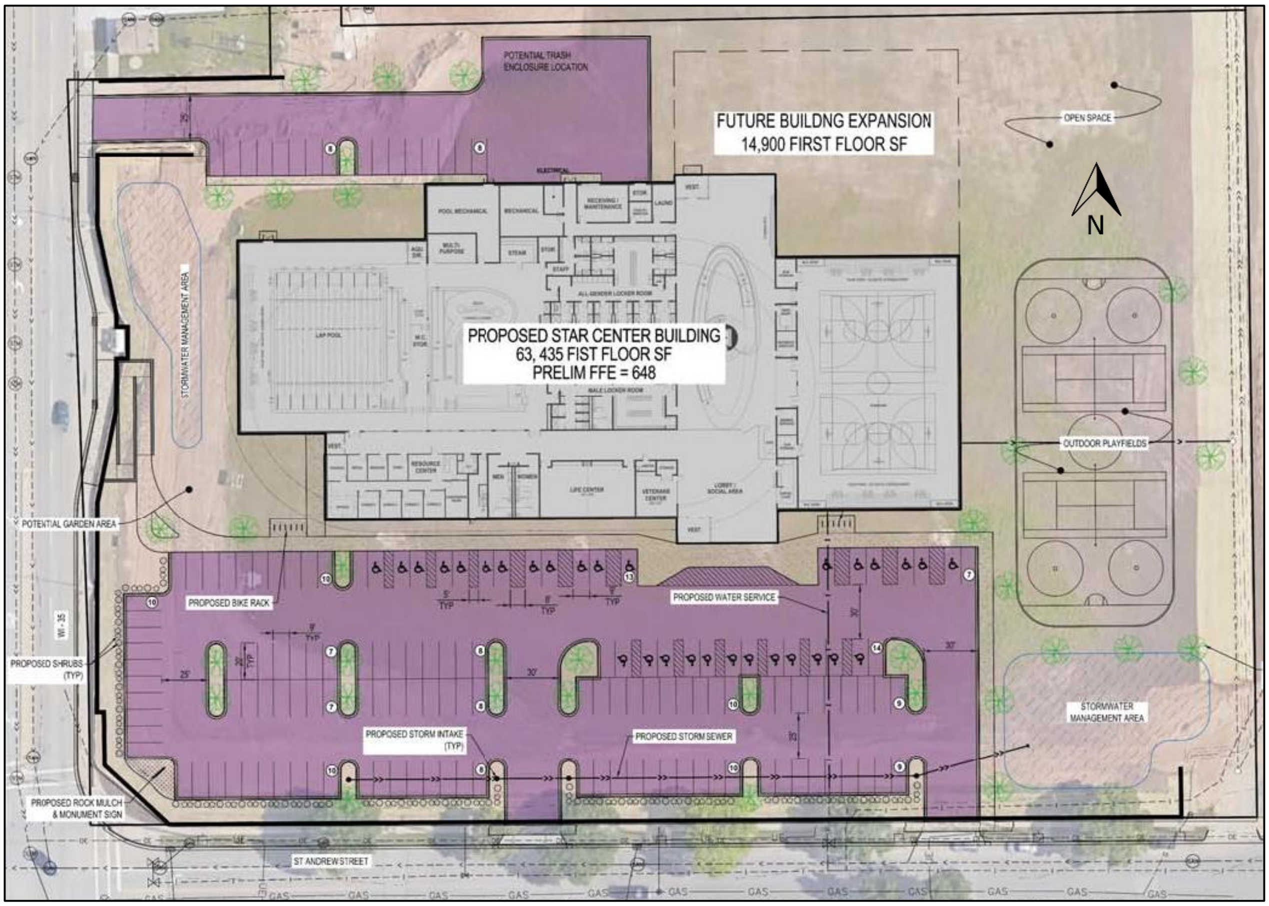


Figure provided by I & S Group, Inc., dated August 2, 2019.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.2. Site Conditions and History

Based on our referenced documents and knowledge of the site, we understand the site was previously developed. The previous structure was demolished and backfilled. To our knowledge, earthwork associated with the backfill, including proper lift thickness, compaction effort, testing records, and documentation of the backfill was not conducted during the demolition process. The site was then elevated above the flood plain by importing approximately 60,000 cubic yards of soil, bringing the site to the approximate elevation of 648. The additional fill brought to the site was tested for in-place density and level of compaction.

The site currently exists as a vacant lot with surficial vegetation. Based on elevations at the boring locations, the site is relatively flat and has less than 1-foot of relief. The photograph below provides an aerial image of the site.

Photograph 1. Aerial Photograph of the Site

Photograph provided by Google Earth, dated September 28, 2015.

A.3. Purpose

The purpose of our geotechnical evaluation was to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact and provide geotechnical recommendations for the design and construction of the proposed building and associated site improvements.

A.4. Background Information and Reference Documents

We reviewed the following information:

- Historical aerial photographs and topographic maps of the site.
- Geologic maps of La Crosse County, Wisconsin.
- Preliminary site layout plan prepared by I & S Group, Inc., dated August 2, 2019.
- Proposed concept design prepared by I & S Group, River Architects, and KPF, dated August 2, 2019.
- Final site grading plan prepared by Cedar Corporation, dated September 2015.
- Previous Geotechnical Evaluation Report prepared by Braun Intertec, project number B1407491, dated December 17, 2014.
- Addendum to Final Case Closure with Continuing Obligations Letter Dated January 30, 2014; Former Trane Company Plant #6 Located at 606 George Street/1319 St. Andrew Street (f/k/a 1305 St. Andrew Street) La Crosse, Wisconsin WDNR BRRT Activity # 02-32-000195 & # 07-32-547753, dated April 30, 2015.
- Communications with River Architects, Inc., and I & S Group, Inc. regarding project details.

Our referenced documents and past project experience in the general area indicate that the site is underlain with engineered fill over uncontrolled fill and undocumented fill over buried topsoil and alluvial sand soils.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal QTB104228 to STAR Association, dated July 17, 2019, who authorized us to proceed. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.

- Staking and clearing the exploration location of underground utilities. I & S Group, Inc. selected, and we staked the boring exploration locations. We acquired the surface elevations and locations with GPS technology using the State of Minnesota's permanent GPS base station network. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.

- Performing six (6) standard penetration test (SPT) borings, denoted as ST-1 to ST-6, to nominal depths of 15 to 30 feet below grade across the site.

- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure and pavement subgrade preparation and the design of foundations, floor slabs, below-grade walls, exterior slabs, pavements, underground utilities, and stormwater improvements.

Our scope of services did not include environmental services or testing, and we did not train the personnel performing this evaluation to provide environmental services or testing. We can provide these services or testing at your request.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Previous Geotechnical Information

We performed six (6) soil borings at this site in October of 2014 and completed a Geotechnical Evaluation Report for a proposed site redevelopment. The previous evaluation was completed prior to the additional fill brought to the site to raise site grades above the flood plain to elevation 648. Those borings encountered approximately 4 to 9 feet of uncontrolled and undocumented fill that contained pockets of debris including concrete, glass, bricks, and large voids over buried topsoil. Below the fill and buried topsoil, the borings encountered alluvial sand soils.

B.3. Boring Results

Table 2 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheets in the Appendix include definitions of abbreviations used in Table 2.

Table 2. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil Fill	SM	---	▪ Topsoil fill was encountered at the ground surface in all borings. ▪ The topsoil fill consisted of silty sand (SM) with roots that was dark brown in color and was moist. ▪ Thicknesses at the boring locations varied from less than ½-foot to 2 feet.

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Engineered Fill	SP, SP-SM	9 to 42 BPF	▪ Engineered fill was encountered below the topsoil in all borings and extended to depths of about 4 to 5 feet. ▪ This fill was placed to elevate the site above the flood plain and has been tested for in-place density and level of compaction during placement. ▪ The fill consisted of fine- to medium-grained poorly graded sand (SP) and poorly graded sand with silt (SP-SM) that was brown and was moist.
Undocumented Fill	SP, SP-SM	4 to 28 BPF	▪ Fill was encountered in all borings below the topsoil fill and engineered fill, and extended to depths of approximately 8 to 17 feet. ▪ General penetration resistance suggests the fill received variable compaction. ▪ The fill consisted of fine- to medium-grained poorly graded sand (SP), poorly graded sand with silt (SP-SM), and silty sand (SM) that was light brown, brown, and yellowish brown in color and was moist to wet. ▪ The fill contained various amounts of gravel.
Alluvial	SP, SP-SM, SM	3 to 21 BPF	▪ Alluvial soils were encountered in all borings below the topsoil fill and fill and extended to the termination depths of our borings. ▪ Penetration resistance testing in the sandy alluvial soils indicates they are very loose to medium dense in relative density. ▪ Consisted of fine- to coarse-grained poorly graded sand (SP), poorly graded sand with silt (SP-SM), and silty sand (SM) that contained with traces of gravel that was brown and gray in color. ▪ Moisture condition was wet. ▪ Trace organics encountered in Boring ST-4 at a depth of 12 to 14 feet.

*Abbreviations defined in the attached Descriptive Terminology sheets.

B.4. Groundwater

Table 3 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the Appendix also include this information and additional details. Corresponding groundwater elevations were determined from comparisons of the measured/estimated depths to groundwater and surface elevations and were rounded to the nearest ½-foot.

Table 3. Groundwater Summary

Location	Surface Elevation	Measured or Estimated Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-1	647.7	11	636 ½
ST-2	647.8	12	636
ST-3	647.7	12	635 ½
ST-4	648.0	11	637
ST-5	647.6	9 ½	638
ST-6	647.9	10	638

At the time of our observation, we observed groundwater at depths of 9 ½ to 12 feet as our borings were advanced. These depths correspond to elevation 635 ½ to 638. Seasonal and annual fluctuations of groundwater should also be anticipated.

B.5. Environmental Discussion

We understand contaminated soil, slag, and rubble were identified in Wisconsin Department of Natural Resources (WDNR) approved NR700 Remedial Action Plan. The cleanup site is register as WDNR BRRTS #02-32-000195 and #07-32-547753. Continuing obligations remain associated with the site. It is imperative that a soil management plan be developed and implemented prior to any earthwork taking placed in the impacted areas. The soil management plan will provide direction to properly handle all impacted soils properly during all aspects of the new construction. We can be contacted to help the project team with the soil management plan prior to construction.

B.6. Laboratory Test Results

Overall, the soils encountered within our borings at this site consisted of sandy soils. These soils are not expansive. More information, soil characteristics, and test results are presented in the following sections.

B.6.a. Mechanical Sieve Analysis Tests

We performed a mechanical sieve analysis (ASTM D6913) on a selected sample from Boring ST-3 at a depth of 20 feet to assist in classification. The test indicated the sample tested classified as poorly graded sand (SP). The Log of Boring sheets present the percent passing a #200 sieve result and the Appendix includes a graph showing the results of the mechanical sieve analysis.

B.6.b. Moisture Content and Particles Passing a #200 Sieve Tests

Results of our laboratory tests for soil classification, moisture content, and particles passing a #200 sieve are presented below in Table 4.

Table 4. Laboratory Classification Test Results

Location	Sample Depth (ft)	Classification	Moisture Content (w, %)	Percent Passing a #200 Sieve
ST-1	5	FILL: Poorly Graded Sand (SP)	8	5
ST-2	6	FILL: Poorly Graded Sand (SP)	8	5
ST-3	20	Poorly Graded Sand (SP)	23	1
ST-4	2 ½	FILL: Poorly Graded Sand with Silt (SP-SM)	9	9
ST-5	2	FILL: Poorly Graded Sand with Silt (SP-SM)	9	10

C. Basis for Recommendations

C.1. Design Considerations

C.1.a. Introduction

The site contains fill that extends to depths of 8 to 17 feet across the site, corresponding to elevation 631 to 640. The fill was noted to have variable compaction and consistency. Based on previous site explorations, buried topsoil is also likely present beneath the fill. These materials are not suitable for support of the proposed building. To limit post-construction settlement, the building should be supported on improved subgrades or intermediate foundation systems. Removal and replacement of the soils will require installation of dewatering systems and careful handling of contaminated fill soils. Installation of intermediate foundation systems, however, would limit the need for dewatering systems and reduce the handling and amount of disturbance to the contaminated soils. After discussing this with I & S Group, Inc. and River Architects, we developed our recommendations for improving subgrades by installation of rammed aggregate piers.

C.1.b. Building Support

As mentioned above, to reduce the risk of future excessive building and site settlements it is our opinion the building will need to be supported on intermediate foundations. The proposed building foundations, pools, and interior slabs should be supported on rammed aggregate piers.

Alternatively, if the owner is willing to accept the risk of some settlement, then the fill below the interior slabs could be surface-compacted and left in place provided the building foundations and pool areas are supported on rammed aggregate piers. The amount of settlement associate with this approach is dependent on the amount of compacted soil below the structure and the composition of the existing fill but is expected to be less than 1-inch under the assumed loads. Additional settlements may occur if undetected loose fill, deleterious material, or voids are present within the fill that were not detected by the soil borings.

There is some risk associated with this approach. The recommendations and parameters discussed below are based on the conditions encountered in our borings and our experiences on similar sites. Please note that actual settlements will vary and could be much higher, if voids or compressible materials are concealed by the fill. The owner needs to accept the additional risk of differential settlement by leaving the fill in place, in return for the cost savings. These risks can be reduced through additional testing and observations but cannot be eliminated unless the fill is removed in its entirety, or an intermediate foundation system is used to support all components of the proposed building.

C.1.c. Swimming Pools and Below-Grade Walls

Swimming pools and below-grade walls should be backfilled with medium- to coarse-grained sand or gravel to limit buildup of hydrostatic pressure on the walls and to promote drainage of subsurface and accumulated water to a drain tile or sump pump.

C.1.d. Pavements

Areas receiving new pavements should be prepared by removing the topsoil fill and surficial vegetation from below the proposed pavement subgrade elevations and be replaced with granular fill. Prior to elevating or placing additional fill required, the exposed subgrade soils should be surface-compacted to densify and enhance uniformity of the exposed soils. The fill present below these materials appeared to be free of debris and can be left in place provided it is evaluated for suitability at the time of construction. If the fill is considered suitable, it should be surface-compacted. If the fill is unsuitable, additional sub-cuts and subgrade improvements may be required. A proofroll should also be performed after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

C.2. Construction Considerations

From a construction perspective, the project team should also be aware that:

- Excavations will penetrate the groundwater surface at a depth of approximately 9 ½ to 12 feet. Dewatering will be required for excavations that extent below elevation 638 to facilitate an evaluation of the geologic materials exposed in the excavation sides and bottoms, and the placement and compaction of backfill.

- The on-site existing fill can be considered for re-use as backfill and additional required fill provided debris and organic soils (if encountered) is first removed. The alluvial soils can also be considered for reuse as backfill and additional required fill.

- Imported material needed to replace excavation spoils or balance cut and fill quantities, should consist of sandy soils having less than 20 percent of the particles by weight passing a #200 sieve. Soil needed to facilitate drainage should consist of sand and gravel soils with less than 5 percent passing a #200 sieve.

D. Recommendations

D.1. Earthwork

D.1.a. Building Subgrade Preparation

We recommend removing the topsoil fill and surficial vegetation from below the proposed building footprint and their oversize areas. To provide support for construction equipment for installation of the rammed aggregate piers, we recommend the building pad be filled to subgrade elevation with granular soils having less than 20 percent passing a #200 sieve followed by 6 inches of aggregate base.

A geotechnical representative should observe the excavations to make the necessary field judgments regarding the suitability of the exposed soils.

D.1.b. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will consist of sandy fill and alluvial sand soils. These soils are considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1 ½H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

D.1.c. Excavation Dewatering

We recommend removing groundwater from the excavations with well points. Dewatering of high-permeability soils (e.g., sands) from within the excavation with conventional pumps has the potential to loosen the soils, due to upward flow. A dewatering contractor should develop a dewatering plan; the design team should review this plan.

D.1.d. Surface Compaction

Due to the areas of loose sandy fill soils below the proposed building and pavement areas, we recommend that exposed soils be surface-compacted prior to placing additional required fill and slabs for the proposed building and pavement areas. This will densify and enhance uniformity of the exposed soils.

D.1.e. Engineered Fill Materials and Compaction

We recommend spreading fill in loose lifts of approximately 12 inches thick. Table 5 below contains our recommendations for fill materials, gradation, and minimum compaction level for compacted fills.

Table 5. Soil for Fill Description*

Fill Classification	Locations to Be Used	Fill Source and Soil Descriptions	Gradation	Relative Compaction, percent (ASTM D1557 – Modified Proctor)
Structural fill	▪ General site grading ▪ Elevating the building pad to finished floor elevation ▪ Interior and exterior foundation wall backfill ▪ Below interior and exterior slabs	On-site fill free of debris or imported sand and gravel consisting of GP, GW, SW, SP, SP-SM, SM	100% passing 2-inch sieve <20% passing #200 sieve < 2% Organic Content (OC)	95
Non-frost-susceptible fill	Non-frost-susceptible below building entry slabs	Imported sand or gravel: GP, GW, SP, SW	100% passing 1-inch sieve < 50% passing #40 sieve < 5% passing #200 sieve < 2% OC	95
Retained fill	Drainage layer behind below-grade walls and retaining walls	Imported sand or gravel: GP, GW, SP, SW	100% passing 3-inch sieve < 5% passing #200 sieve < 2% OC	95
	Re-placed or retained on-site soils	On-site soils or imported sand and gravel consisting of GP, GW, SW, SP, SP-SM, SM	100% passing 2-inch sieve <20% passing #200 sieve < 2% OC	95
Non-structural fill	Below landscaped surfaces, where subsidence is not a concern	On-site soils and imported soils	100% passing 6-inch sieve < 10% OC	90

* More select soils comprised of coarse sands with < 5% passing #200 sieve may be needed to accommodate work occurring in periods of wet or freezing weather.

Sand soil with less than 12 percent particles by weight passing a number 200 sieve may be compacted without moisture conditioning, although, some water may be needed to achieve compaction. Silty sand, soils used as backfill should be moisture conditioned to between 3 percent below to 3 percent above their optimum moisture content.

The project documents should not allow the contractor to use frozen material as fill or to place fill on frozen material. Frost should not penetrate under foundations or slabs during construction.

We recommend performing density tests in fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

D.2. Foundation Support on Rammed Aggregate Piers

D.2.a. Rammed Aggregate Piers

Based on the anticipated depth of excavations needed to remove the existing fill from the proposed building footprint, it appears that conventional soil corrections would add a significant cost to the project. Thus, we recommend performing ground improvements with rammed aggregate piers.

A subgrade improved with rammed aggregate piers will reduce the potential for detrimental settlement associated with the existing fill to occur, provide adequate bearing capacity, eliminate the need for deep excavations, reduce the need to dewatering excavations, reduce the need to handle contaminated soils, reduce impacts to adjacent site features, and reduce the volume of subgrade soils disturbed at this site.

Different contractors use varying techniques to construct rammed aggregate piers, but generally consist of excavating soil from a hole with an auger or vibrating a probe into the ground, and then building a column of clean, open-graded aggregate. The contractor constructs the pier by placing the aggregate in lifts from the bottom of the pier and compacting each lift before placing aggregate for the subsequent lift. The vibratory energy, and sometimes ramming action, causes the aggregate to interlock, forming a stiff pier that provides soil reinforcement and increases shear resistance. Due to the many variations in techniques, we recommend using performance-based specifications with design-build contracting. We recommend requiring the contractor to have at least five years of experience in performing this work, and to demonstrate performing the proposed protection system(s) on at least three previous projects of similar size and scope. The specifications should require the design engineer be licensed in the project state. We can assist you with developing a list of pre-qualified contractors prior to bidding or with reviewing contractor experience as part of the bidding process.

Rammed aggregate piers are a Special Inspection item in accordance with Chapter 17 of the IBC. The observations should include installed length, consistency of soil profile with the geotechnical evaluation confirmation of the materials, and confirmation of installation techniques.

We recommend installing rammed aggregate piers under both foundations and pools for the building. The rammed aggregate piers should extend through the existing fill to bear on the alluvial sand soils at depth.

D.2.b. Spread Footing Design Parameters

Table 6 below contains our design parameters for foundations supported on rammed aggregate piers.

Table 6. Recommended Spread Footing Design Parameters on Rammed Aggregate Piers

Item	Description
Maximum net allowable bearing pressure (psf) Interior column pad footings Perimeter strip footings	Determined by aggregate pier designer.
Minimum embedment below final exterior grade for heated structures (inches)	48
Minimum embedment below final exterior grade for unheated structures or for footings not protected from freezing temperatures during construction (inches)	60
Total and Differential settlement	Typically, less than 1-inch and ½-inch, respectively. *

* Actual settlement amounts will depend on final loads, foundation layout, and design criteria from aggregate pier designer.

D.3. Interior Slabs

D.3.a. Subgrade Modulus

We recommend the interior slabs be supported on rammed aggregate piers that extend through the existing fill to bear on the alluvial sand soils at depth. The aggregate pier designer will provide a modulus of subgrade reaction for slab design based on the pier layout and load transfer platform design.

Alternatively, if the owner is willing to accept the risk of some settlement, then interior slabs could be supported on the existing fill provided it is surface-compacted prior to place additional fill required or concrete. Interiors slabs supported on surface-compacted engineered fill may be designed using a modulus of subgrade reaction, k, of 200 pounds per square inch per inch of deflection (pci). If the slab design requires placing 6 inches of compacted crushed aggregate base immediately below the slab, the slab design may increase the k-value by 50 pci. We recommend that the aggregate base materials be free of bituminous. In addition to improving the modulus of subgrade reaction, an aggregate base facilitates construction activities and is less weather sensitive.

There is an elevated risk of settlement with this approach based on the nature of the fill and that the fill could contain voids or compressible materials. The owner needs to accept the additional risk of differential settlement by leaving a portion of the fill in place, in return for the cost savings. These risks can be reduced through additional testing and observations but cannot be eliminated unless the interior slabs are supported on rammed aggregate piers.

D.3.b. Moisture Vapor Protection

Excess transmission of water vapor could cause floor dampness, certain types of floor bonding agents to separate, or mold to form under floor coverings. If project planning includes using floor coverings or coatings, we recommend placing a vapor retarder or vapor barrier immediately beneath the slab. We also recommend consulting with floor covering manufacturers regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.

D.3.c. Water Table Separation

We recommend maintaining a 5-foot separation from anticipated long-term water levels. This separation will reduce the risk of seepage, buoyant forces, and other water related issues.

D.4. Swimming Pool and Therapy Pool

D.4.a. Swimming Pool and Therapy Pool Support

We understand the swimming pool and therapy pool will be supported on rammed aggregate piers with a structural floor slab around the pools.

D.4.b. Hydrostatic Pressure

The swimming pool and therapy pool should be designed for hydrostatic uplift up to elevation 641 (this is the anticipated groundwater elevation due to seasonal fluctuation).

We recommend the fill located within 5 feet of the walls consist of free-draining fill with less than 5 percent passing a #200 sieve. This material will control lateral pressures on the wall. If final design uses non-sand material for fill, project planning should account for the following items:

- Other fill material may result in higher lateral pressure on the wall.
- Other fill material may be more difficult to compact.
- Post-construction consolidation of other fill material may result in settlement-related damage to the structures or slabs supported on the fill.

D.4.c. Configuring and Resisting Lateral Loads

The swimming pool and therapy pool wall design can use at-rest earth pressure conditions. Table 7 presents our recommended equivalent fluid pressures for wall design of active, at-rest, and passive earth pressure conditions. The table also provides recommended wet unit weights and internal friction angles. Designs should also consider the slope of any fill and dead or live loads placed behind the walls within a horizontal distance that is equal to the height of the walls. Our recommended values assume the wall design provides drainage, so water cannot accumulate behind the walls. The construction documents should clearly identify what soils the contractor should use for the fill of walls.

Table 7. Recommended Pool Wall Design Parameters – Drained Conditions

Retained Soil	Wet Unit Weight (pcf)	Friction Angle (degrees)	Active Equivalent Fluid Pressure* (pcf)	At-Rest Equivalent Fluid Pressure* (pcf)	Passive Equivalent Fluid Pressure* (pcf)
Free-draining fill	120	32	37	56	390

* Based on Rankine model for soils in a region behind the wall extending at least 2 horizontal feet beyond the bottom outer edges of the wall footings and then rising up and away from the wall at an angle no steeper than 60 degrees from horizontal.

The values presented in the table above are un-factored.

D.5. Below-Grade Walls

D.5.a. Below-Grade Wall Support

We understand the below-grade walls for elevator pits and pool maintenance room will be supported by rammed aggregate piers with a concrete floor slab below.

D.5.b. Hydrostatic Pressure

Below-grade walls that extent below the groundwater table should be designed for hydrostatic uplift up to elevation 641 (this is the anticipated groundwater elevation due to seasonal fluctuation).

We recommend the fill located within 5 feet of the walls consist of free-draining fill with less than 5 percent passing a #200 sieve. This material will control lateral pressures on the wall. If final design uses non-sand material for fill, project planning should account for the following items:

- Other fill material may result in higher lateral pressure on the wall.
- Other fill material may be more difficult to compact.
- Post-construction consolidation of other fill material may result in settlement-related damage to the structures or slabs supported on the fill.

D.5.c. Drainage Control and Waterproofing

We recommend below-grade walls be backfilled with medium- to coarse-grained sand or gravel to limit buildup of hydrostatic pressure on the walls. We also recommend general waterproofing of below-grade walls that surround occupied or potentially occupied areas because of the potential cost impacts related to seepage after construction is complete.

D.5.d. Configuring and Resisting Lateral Loads

Below-grade wall design can use at-rest earth pressure conditions. Table 8 presents our recommended equivalent fluid pressures for wall design of active, at-rest, and passive earth pressure conditions. The table also provides recommended wet unit weights and internal friction angles. Designs should also consider the slope of any fill and dead or live loads placed behind the walls within a horizontal distance that is equal to the height of the walls. Our recommended values assume the wall design provides drainage, so water cannot accumulate behind the walls. The construction documents should clearly identify what soils the contractor should use for the fill of walls.

Table 8. Recommended Below-Grade Wall Design Parameters – Drained Conditions

Retained Soil	Wet Unit Weight (pcf)	Friction Angle (degrees)	Active Equivalent Fluid Pressure* (pcf)	At-Rest Equivalent Fluid Pressure* (pcf)	Passive Equivalent Fluid Pressure* (pcf)
Free-draining fill	120	32	37	56	390

* Based on Rankine model for soils in a region behind the wall extending at least 2 horizontal feet beyond the bottom outer edges of the wall footings and then rising up and away from the wall at an angle no steeper than 60 degrees from horizontal.

Sliding resistance between the bottom of the footing and the soil can also resist lateral pressures. We recommend assuming a sliding coefficient equal to 0.40 between the concrete and soil.

The values presented in this section are un-factored.

D.6. Pavements and Exterior Slabs

D.6.a. Pavement Subgrade Preparation

We recommend areas receiving new pavement be prepared by removing the topsoil fill and surficial vegetation from below the proposed pavement subgrade elevations and be replaced with granular fill. Prior to elevating or placing additional fill required, we recommend surface-compacting the exposed subgrade soils to densify and enhance uniformity of the exposed soils. The fill present below these materials appeared to be free of debris and could be left in place provided it is evaluated for suitability at the time of construction. If the fill is considered suitable, it should be surface compacted. If the fill is unsuitable, additional sub-cuts and subgrade improvements may be required.

We also recommend performing a proofroll with a fully loaded tandem-axle truck after the aggregate base material is in place, and prior to placing bituminous or concrete pavement. The contractor should correct areas that display excessive yielding or rutting during the proofroll, as determined by the geotechnical representative. Possible options for subgrade correction include moisture conditioning and re-compaction or sub-cutting and replacement with soil or crushed aggregate.

D.6.b. Pavement and Exterior Slab Design Sections

Our scope of services for this project did not include laboratory tests on subgrade soils to determine a California Bearing Ratio (CBR) value for pavement design. Based on our experience with sand soils anticipated at the pavement subgrade elevation, we recommend pavement design assume a CBR-value of 15. Note the contractor may need to perform limited removal of unsuitable or less suitable soils and surface compact subgrade soils to achieve this value. Table 9 provides recommended bituminous pavement sections, based on the soils estimated support and assumed traffic loads.

Table 9. Recommended Bituminous Pavement Sections

Pavement Material	Light Duty Pavements Thickness/Preparations	Heavy Duty Pavements Thickness/Preparations
Minimum Bituminous Thickness (in.)	3	4
Minimum Aggregate Base Thickness (in.)	8	12
Subgrade Preparation	Surface compact, then proofroll after placement of aggregate base to locate loose or weak subgrade materials prior to placement of pavement materials.	

For concrete pavements based upon the aforementioned traffic loads and an estimated modulus of subgrade reaction (k) of 200 pci, we recommend light- and heavy-duty pavement section as shown in Table 10 below.

Table 10. Recommended Concrete Pavement Sections

Pavement Material	Light Duty Pavements Thickness/Preparations	Heavy Duty Pavements Thickness/Preparations
Minimum Concrete Thickness (in.)	5	6 ½
Minimum Aggregate Base Thickness (in.)	4	4
Subgrade Preparation	Surface compact, then proofroll after placement of aggregate base to locate loose or weak subgrade materials prior to placement of pavement materials.	

D.6.c. Bituminous Pavements

Appropriate mix designs are critical to the performance of flexible pavements. We recommend utilizing hot mix asphalt meeting the specifications of Wisconsin Department of Transportation (WisDOT) Section 460. We recommend utilizing a nominal 12.5 mm gradation for the base course and a nominal 9.5 mm gradation for the surface course as defined in Table 460-1 in Section 460.2.2.3. We recommend the Performance Graded Asphalt cement be a PG 58-28 in the lower layer and a PG 58-28 in the upper layer.

D.6.d. Concrete Pavements

We recommend specifying concrete for pavements that has a minimum 28-day compressive strength of 4,000 psi, and a modulus of rupture (M_r) of at least 600 psi. We also recommend Type I cement meeting the requirements of ASTM International C 150. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration. We also recommend using a water/cement ratio of 0.45 or less for concrete exposed to deicers.

We assumed the concrete pavement sections in Table 10 will have edge support. We recommend placing an aggregate base below the pavement to provide a suitable subgrade for concrete placement, reduce faulting and help dissipate loads. Appropriate mix designs, panel sizing, jointing, doweling and edge reinforcement are critical to performance of rigid pavements. We recommend you contact your civil engineer to determine the final design or consult with us for guidance on these items.

D.6.e. Pavement Materials and Compaction

Table 11 below contains our recommendations for fill materials, minimum compaction level, and moisture content for compacted fills.

Table 11. Recommended Pavement Materials and Compaction

Locations to Be Used	Fill Source and Soil Descriptions	Gradation	Relative Compaction, percent (ASTM D1557 – Modified Proctor)	Moisture Content Variance from Optimum, percentage points
Dense Graded Base	Imported aggregate	WisDOT Standard Spec 305 Dense Graded Base	95	-3 to +3 for aggregate base
Granular Subbase	Imported sand and gravel	WisDOT Standard Spec 209 Grade 1 or Grade 2	95	-6 to +3 for granular subbase
Pavements subgrades and grading	On-site soils	100% passing 3-inch sieve < 2% OC	95	-6 to +3 for pavement subgrade

D.6.f. Performance and Maintenance

We based the above pavement designs on a 20-year performance life for bituminous and a 35-year life for concrete. This is the amount of time before we anticipate the pavement will require reconstruction. This performance life assumes routine maintenance, such as seal coating and crack sealing. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

It is common to place the binder course of bituminous and then delay placement of wear course. For this situation, we recommend evaluating if the reduced pavement section will have sufficient structure to support construction traffic.

Many conditions affect the overall performance of the exterior slabs and pavements. Some of these conditions include the environment, loading conditions and the level of ongoing maintenance. With regard to bituminous pavements in particular, it is common to have thermal cracking develop within the first few years of placement and continue throughout the life of the pavement. We recommend developing a regular maintenance plan for filling cracks in exterior slabs and pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade.

D.7. Utilities

D.7.a. Subgrade Stabilization

Earthwork activities associated with utility installations located inside the building area should adhere to the recommendations in Section D.1.

For exterior utilities, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils or perched water at invert grades, the unsuitable soils may require some additional sub cutting and replacement with sand or crushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of foundations.

D.7.b. Corrosion Potential

A majority of the soil borings indicated the site predominantly consists of sandy soils. We consider these soils non- to slightly-corrosive to metallic conduits. If utilities extend through clay soils, we recommend bedding the utilities in sandy soil free of any clay lumps or constructing the utilities with non-corrosive materials.

D.8. Storm Water

Borings ST-2, ST-3, ST-5, and ST-6 were drilled and sampled continuously to depths of approximately 15 feet near the proposed storm water drainage system locations. The borings encountered fill and alluvial soils consisting of fine- to coarse-grained loamy sand, sandy loam, and sand. Groundwater was encountered at depths of 9 ½ to 12 feet as our borings were advanced. These depths correspond to elevation 635 ½ to 638 and are the elevations of the limiting factor per the Wisconsin DNR. Seasonal and annual fluctuations of groundwater should also be anticipated.

Infiltration rates associated with the soils present at this location are included on the Soil Evaluation – Storm form included in the Appendix of this report. The reported infiltration rates were determined by referencing Table 2 in the Wisconsin DNR Storm Water Infiltration Technical Standard 1002, dated September 2017.

Fine-grained soils (silts and clays), topsoil or organic matter that mixes into or washes onto the soil will lower the permeability. The contractor should maintain and protect infiltration areas during construction. Furthermore, organic matter and silt washed into the system after construction can fill the soil pores and reduce permeability over time. Proper maintenance is important for long-term performance of infiltration systems.

This geotechnical evaluation does not constitute a review of site suitability for storm water infiltration or evaluate the potential impacts, if any, from infiltration of large amounts of storm water.

D.9. Equipment Support

The recommendations included in the report may not be applicable to equipment used for the construction and maintenance of this project. We recommend evaluating subgrade conditions in areas of shoring, scaffolding, cranes, pumps, lifts and other construction equipment prior to mobilization to determine if the exposed materials are suitable for equipment support or require some form of subgrade improvement. We also recommend project planning consider the effect that loads applied by such equipment may have on structures they bear on or surcharge – including pavements, buried utilities, below-grade walls, etc. We can assist you in this evaluation.

E. Procedures

E.1. Penetration Test Borings

We drilled the penetration test borings with a truck-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 ½- or 5-foot intervals in general accordance to ASTM D1586. The boring logs show the actual sample intervals and corresponding depths.

We sealed penetration test boreholes meeting the Wisconsin Administrative Code NR 141.25 criteria using 3/8-inch bentonite chips. A copy of the sealing record can be obtained upon request.

E.2. Exploration Logs

E.2.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

E.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

E.3. Material Classification and Testing

E.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

E.3.b. Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM procedures.

E.4. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

F.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

F.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

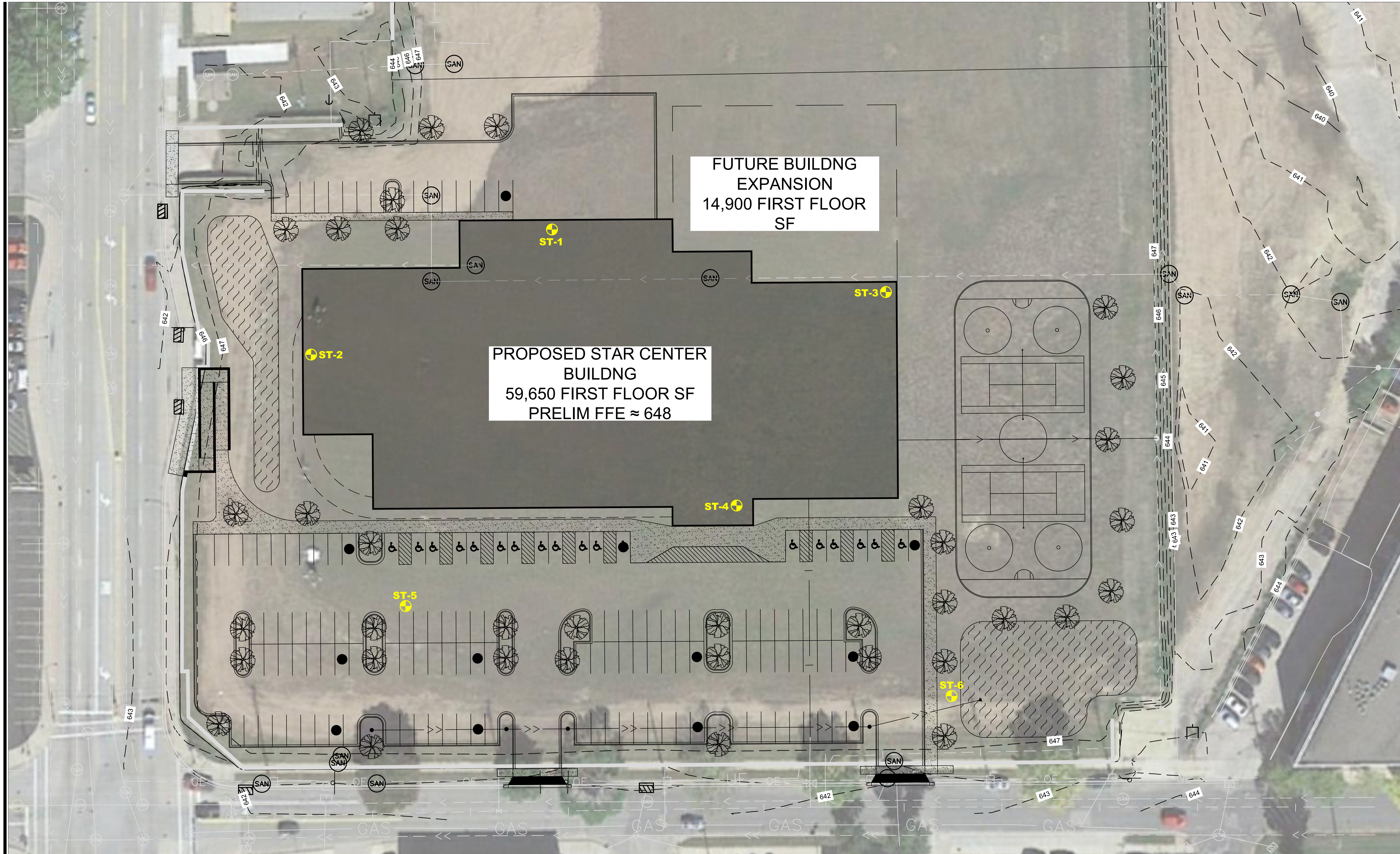
F.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix



DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

30' 0 60'

SCALE: 1"= 60'

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Minneapolis, MN 55438
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braunintertec.com

Drawing Information

Project No: B1907847

Drawing No: B1907847

Drawn By:	JAG
Date Drawn:	7/23/19
Checked By:	BS
Last Modified:	7/31/19

Project Information

Proposed STAR Center Facility

1319 and 1325 St. Andrew Street

La Crosse, Wisconsin

Soil Boring Location Sketch

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-1** LOCATION: See attached sketch	NORTHING: 139810	EASTING: 448635
DRILLER: Geotechnical Drilling Contractors	LOGGED BY: B. Sullivan	START DATE: 07/30/19	END DATE: 07/30/19
SURFACE ELEVATION: 647.7 ft	RIG: Subcontractor / METHOD: 4 1/4" HSA	SURFACING: Grass	WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
647.2 / 0.5		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					Benchmark: Boring elevations and surface elevations were measured with GPS technology.
		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, moist to wet					
			X	6-8-11 (19)			
		5	X	5-7-12 (19)		8	P200=5%
			X	7-7-14 (21)			
		10	X	6-8-12 (20)			
	▽						
			X	5-7-8 (15)			
634.7 / 13.0		POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, wet, loose (ALLUVIUM)					
		15	X	4-4-6 (10)			
630.7 / 17.0		POORLY GRADED SAND (SP), fine to coarse-grained Sand, trace Gravel, brown, wet, loose (ALLUVIUM)					
			X	3-4-5			

Continued on next page

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-1** LOCATION: See attached sketch NORTHING: 139810 EASTING: 448635
DRILLER: Geotechnical Drilling Contractors LOGGED BY: B. Sullivan	START DATE: 07/30/19 END DATE: 07/30/19
SURFACE ELEVATION: 647.7 ft RIG: Subcontractor METHOD: 4 1/4" HSA	SURFACING: Grass WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		POORLY GRADED SAND (SP), fine to coarse-grained Sand, trace Gravel, brown, wet, loose (ALLUVIUM)	X	(9)			
		25	X	4-4-5 (9)			
619.7 28.0		POORLY GRADED SAND (SP), fine-grained Sand, brown, wet, loose (ALLUVIUM)					
		30	X	2-3-5 (8)			
616.7 31.0		END OF BORING Boring immediately backfilled with bentonite grout					Water observed at 11.0 feet while drilling. Cave-in depth of 13.0 feet immediately after withdrawal of auger.
		35					

LOG OF BORING

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-2** LOCATION: See attached sketch NORTHING: 139731		EASTING: 448482
DRILLER: Geotechnical Drilling Contractors	LOGGED BY: B. Sullivan	START DATE: 07/30/19	END DATE: 07/30/19
SURFACE ELEVATION: 647.8 ft	RIG: Subcontractor; METHOD: 4 1/4" HSA	SURFACING: Grass	WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample Depth	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					
645.8 / 2.0		FILL: POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained Sand, brown, moist		4-6 (10)			
644.8 / 3.0		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, trace Gravel, yellowish brown, moist to wet		6-8 (14)			
				6-14 (20)			
			5	21-21 (42)		8	P200=5%
				14-14 (28)			
				11-12 (23)			
				10-11 (21)			
				14-14 (28)			
			10	8-12 (20)			
				12-12 (24)			
	▽			8-10 (18)			
				10-9 (19)			
				8-12 (20)			
			15	7-7 (14)			No recovery
630.8 / 17.0		POORLY GRADED SAND (SP), fine to coarse-grained Sand, trace Gravel, brown, wet, medium dense to loose (ALLUVIUM)					
				3-4-7			

Continued on next page

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-2** LOCATION: See attached sketch		
	NORTHING: 139731	EASTING: 448482	
DRILLER: Geotechnical Drilling Contractors	LOGGED BY: B. Sullivan	START DATE: 07/30/19	END DATE: 07/30/19
SURFACE ELEVATION: 647.8 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING: Grass
			WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		POORLY GRADED SAND (SP), fine to coarse-grained Sand, trace Gravel, brown, wet, medium dense to loose (ALLUVIUM)	X	(11)			
		25	X	3-4-6 (10)			
		30	X	3-3-4 (7)			
616.8 31.0		END OF BORING Boring immediately backfilled with bentonite grout					Water observed at 12.0 feet while drilling. Cave-in depth of 11.0 feet immediately after withdrawal of auger.
		35					

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-3** LOCATION: See attached sketch		
	NORTHING: 139771	EASTING: 448847	
DRILLER: Geotechnical Drilling Contractors	LOGGED BY: B. Sullivan	START DATE: 07/30/19	END DATE: 07/30/19
SURFACE ELEVATION: 647.7 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING: Grass	WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
647.0 / 0.7		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					
635.7 / 12.0		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, moist		4-5 (9)			
				5-7 (12)			
				4-5 (9)			
				6-5 (11)			
				4-4 (8)			
				2-2 (4)			
				5-8 (13)			No recovery
				8-7 (15)			
				5-7 (12)			
				7-7 (14)			
630.7 / 17.0	▽ (12.0)	POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained Sand, brownish gray, moist (ALLUVIUM)		7-8 (15)			
				8-10 (18)			
				5-8 (13)			
				10-11 (21)			
		POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, wet, loose to medium dense (ALLUVIUM)		2-2-3		23	P200=1%

Continued on next page

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-3** LOCATION: See attached sketch	NORTHING: 139771	EASTING: 448847
DRILLER: Geotechnical Drilling Contractors	LOGGED BY: B. Sullivan	START DATE: 07/30/19	END DATE: 07/30/19
SURFACE ELEVATION: 647.7 ft	RIG: Subcontractor; METHOD: 4 1/4" HSA	SURFACING: Grass	WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Depth	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, wet, loose to medium dense (ALLUVIUM)		X	(5)			
			25	X	4-5-7 (12)			
			30	X	3-5-7 (12)			
616.7 31.0		END OF BORING Boring immediately backfilled with bentonite grout						Water observed at 12.0 feet while drilling. Cave-in depth of 15.0 feet immediately after withdrawal of auger.
			35					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-4** LOCATION: See attached sketch NORTHING: 139635 EASTING: 448752
DRILLER: Geotechnical Drilling Contractors LOGGED BY: B. Sullivan	START DATE: 07/30/19 END DATE: 07/30/19
SURFACE ELEVATION: 648.0 ft RIG: Subcontractor METHOD: 4 1/4" HSA	SURFACING: Grass WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
646.8 / 1.2		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					
636.0 / 12.0	▽	FILL: POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained Sand, brown, moist	X	6-8-12 (20)		9	P200=9%
			X	8-12-12 (24)			
			X	4-5-6 (11)			
			X	4-4-5 (9)			
634.0 / 14.0		SILTY SAND (SM), fine to medium-grained Sand, trace organics, gray, wet, loose (ALLUVIUM)	X	3-4-4 (8)			
631.0 / 17.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained Sand, brownish gray, wet, loose (ALLUVIUM)	X	2-3-4 (7)			
		POORLY GRADED SAND (SP), fine to medium-grained Sand, light brown, wet, loose to medium dense (ALLUVIUM)	X	2-4-6			

Continued on next page

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847 **Geotechnical Evaluation** **Proposed STAR Center Facility** **1319 and 1325 Saint Andrew Street** **La Crosse, Wisconsin**	BORING: **ST-4** LOCATION: See attached sketch NORTHING: 139635 EASTING: 448752
DRILLER: Geotechnical Drilling Contractors; LOGGED BY: B. Sullivan	START DATE: 07/30/19; END DATE: 07/30/19
SURFACE ELEVATION: 648.0 ft; RIG: Subcontractor; METHOD: 4 1/4" HSA	SURFACING: Grass; WEATHER: Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		POORLY GRADED SAND (SP), fine to medium-grained Sand, light brown, wet, loose to medium dense (ALLUVIUM)	X	(10)			
25			X	3-5-9 (14)			
30			X	5-7-7 (14)			
617.0 / 31.0		END OF BORING Boring immediately backfilled with bentonite grout					Water observed at 11.0 feet while drilling. Cave-in depth of 12.5 feet immediately after withdrawal of auger.
35							

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847
Geotechnical Evaluation
Proposed STAR Center Facility
1319 and 1325 Saint Andrew Street
La Crosse, Wisconsin

BORING:	**ST-5**		
LOCATION: See attached sketch			
NORTHING:	139572	EASTING:	448542
DRILLER:	Geotechnical Drilling Contractors	LOGGED BY:	B. Sullivan
START DATE:	07/30/19	END DATE:	07/30/19
SURFACE ELEVATION:	647.6 ft	RIG:	Subcontractor
METHOD:	4 1/4" HSA		
SURFACING:	Grass	WEATHER:	Sunny

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					
645.8 / 1.8		FILL: POORLY GRADED SAND with SILT (SP-SM), with Gravel, brown, moist	X	10-10 (20)		9	P200=10%
			X	12-14 (26)			
			X	12-12 (24)			
		5	X	14-7 (21)			
641.6 / 6.0		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, trace Gravel, brown, moist	X	10-10 (20)			
			X	11-14 (25)			
			X	6-8 (14)			
	▽		X	2-3 (5)			
637.6 / 10.0		POORLY GRADED SAND (SP), fine-grained Sand, brown, wet, very loose to medium dense (ALLUVIUM)	X	2-1 (3)			
			X	3-3 (6)			
		Silt seam at 12 feet	X	2-4 (6)			
			X	5-7 (12)			
			X	2-4 (6)			
		15	X	6-4 (10)			
631.6 / 16.0		END OF BORING Boring immediately backfilled with bentonite grout					Water observed at 9.5 feet while drilling.

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LOG OF BORING

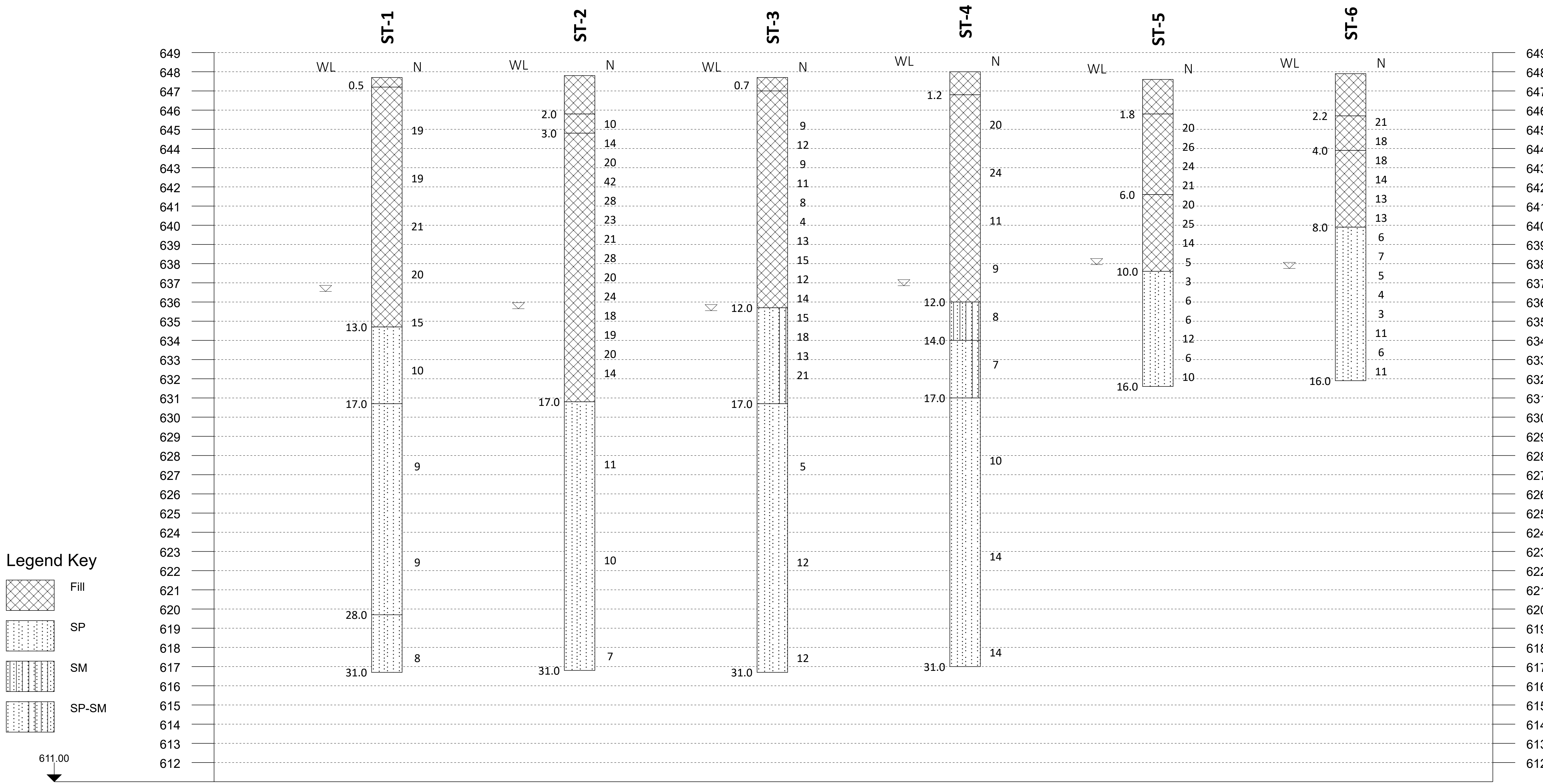
See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1907847
Geotechnical Evaluation
Proposed STAR Center Facility
1319 and 1325 Saint Andrew Street
La Crosse, Wisconsin

BORING:	**ST-6**		
LOCATION: See attached sketch			
NORTHING:	139514	EASTING:	448889
START DATE:	07/30/19	END DATE:	07/30/19
SURFACING:	Grass	WEATHER:	Sunny

DRILLER:	Geotechnical Drilling Contractors	LOGGED BY:	B. Sullivan		
SURFACE ELEVATION:	647.9 ft	RIG:	Subcontractor	METHOD:	4 1/4" HSA

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
		SILTY SAND (SM), fine-grained Sand, with roots, dark brown, moist (TOPSOIL FILL)					
645.7 / 2.2		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, brown, moist	X	10-11 (21)			
			X	9-9 (18)			
643.9 / 4.0		FILL: POORLY GRADED SAND (SP), fine to medium-grained Sand, light brown, moist	X	9-9 (18)			
			X	8-6 (14)			
			X	6-7 (13)			
			X	7-6 (13)			
639.9 / 8.0		POORLY GRADED SAND (SP), fine to medium-grained Sand, black, moist to wet, very loose to medium dense (ALLUVIUM)	X	3-3 (6)			
			X	3-4 (7)			
	▽ (10.0)		X	2-3 (5)			
			X	2-2 (4)			
			X	1-2 (3)			
			X	4-7 (11)			
			X	3-3 (6)			
			X	4-7 (11)			
631.9 / 16.0		END OF BORING Boring immediately backfilled with bentonite grout					Water observed at 10.0 feet while drilling. Cave-in depth of 11.0 feet immediately after withdrawal of auger.



Project ID: B1907847
Vert. Scale: 1"= 5"
Hor. Scale: NTS
Date: 08-07-2019

Fence Diagram
Geotechnical Evaluation
Proposed STAR Center Facility
1319 and 1325 Saint Andrew Street
La Crosse, Wisconsin

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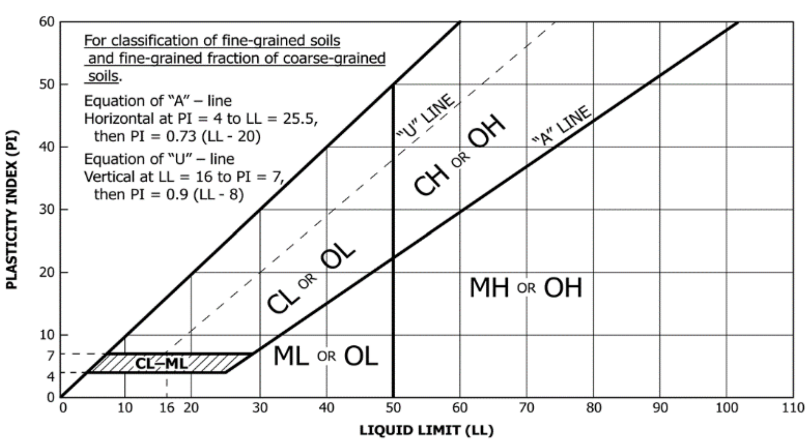
Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay [K L M N] / Organic silt [K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay [K L M P] / Organic silt [K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   - GW-GM well-graded gravel with silt
   - GW-GC well-graded gravel with clay
   - GP-GM poorly graded gravel with silt
   - GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \, x \, D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   - SW-SM well-graded sand with silt
   - SW-SC well-graded sand with clay
   - SP-SM poorly graded sand with silt
   - SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Particle Size Identification

Boulders............. over 12"
Cobbles................ 3" to 12"
Gravel
  Coarse............. 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine................ No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse............. No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium........... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine................. No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt....................... No. 200 (0.075 mm) to .005 mm
Clay...................... < .005 mm

Relative Proportions[L, M]

trace............................ 0 to 5%
little............................ 6 to 14%
with............................. ≥ 15%

Inclusion Thicknesses

lens.............................. 0 to 1/8"
seam............................ 1/8" to 1"
layer............................ over 1"

Apparent Relative Density of Cohesionless Soils

Very loose .... 0 to 4 BPF
Loose .... 5 to 10 BPF
Medium dense............. 11 to 30 BPF
Dense........................... 31 to 50 BPF
Very dense................... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft..................	0 to 1 BPF..................	< 0.25 tsf
Soft..........................	2 to 4 BPF..................	0.25 to 0.5 tsf
Medium...................	5 to 8 BPF	0.5 to 1 tsf
Stiff..........................	9 to 15 BPF................	1 to 2 tsf
Very Stiff..................	16 to 30 BPF..............	2 to 4 tsf
Hard.........................	over 30 BPF...............	> 4 tsf

Moisture Content:

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.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %	**LL**	Liquid limit
WD	Wet density, pcf	**q_p**	Pocket penetrometer strength, tsf	**PL**	Plastic limit
P200	% Passing #200 sieve	**MC**	Moisture content, %	**PI**	Plasticity index
		q_U	Unconfined compression test, tsf		

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Sieve Analysis Of Soil

ASTM D6913

2309 Palace Street
La Crosse, WI 54603
Phone: 608-781-7277

Client:

STAR (Sports, Therapeutic and Adaptive Recreation) Association
PO Box 1024
Lacrosse, WI 54602

Project:

B1907847
Proposed STAR Center Facility
1319 and 1325 Saint Andrew Street
La Crosse, WI 54602

Sample Information

Sample Number: 258813

Depth (ft): 20

Sampling Method: Penetration Boring ASTM D1586

Sampled By: Contractor

Boring Number: ST-3

Location: Native Soil

Location Details: Proposed building footprint

Sample Date: 07/30/2019

Received Date: 07/31/2019

Lab: 2309 Palace Street, La Crosse, WI

Tested Date: 08/02/2019

Sieve Data

Sieve Size	Percent Passing	Specifications
4.75 mm (No. 4)	100	-
2 mm (No. 10)	100	-
850 µm (No. 20)	99	-
600 µm (No. 30)	96	-
425 µm (No. 40)	74	-
300 µm (No. 50)	22	-
250 µm (No. 60)	11	-
150 µm (No. 100)	3	-
75 µm (No. 200)	1.3	-

Classification: SP Poorly graded sand

Specimen Obtained: Moist

Test Method: Method A (Composite Sieving)

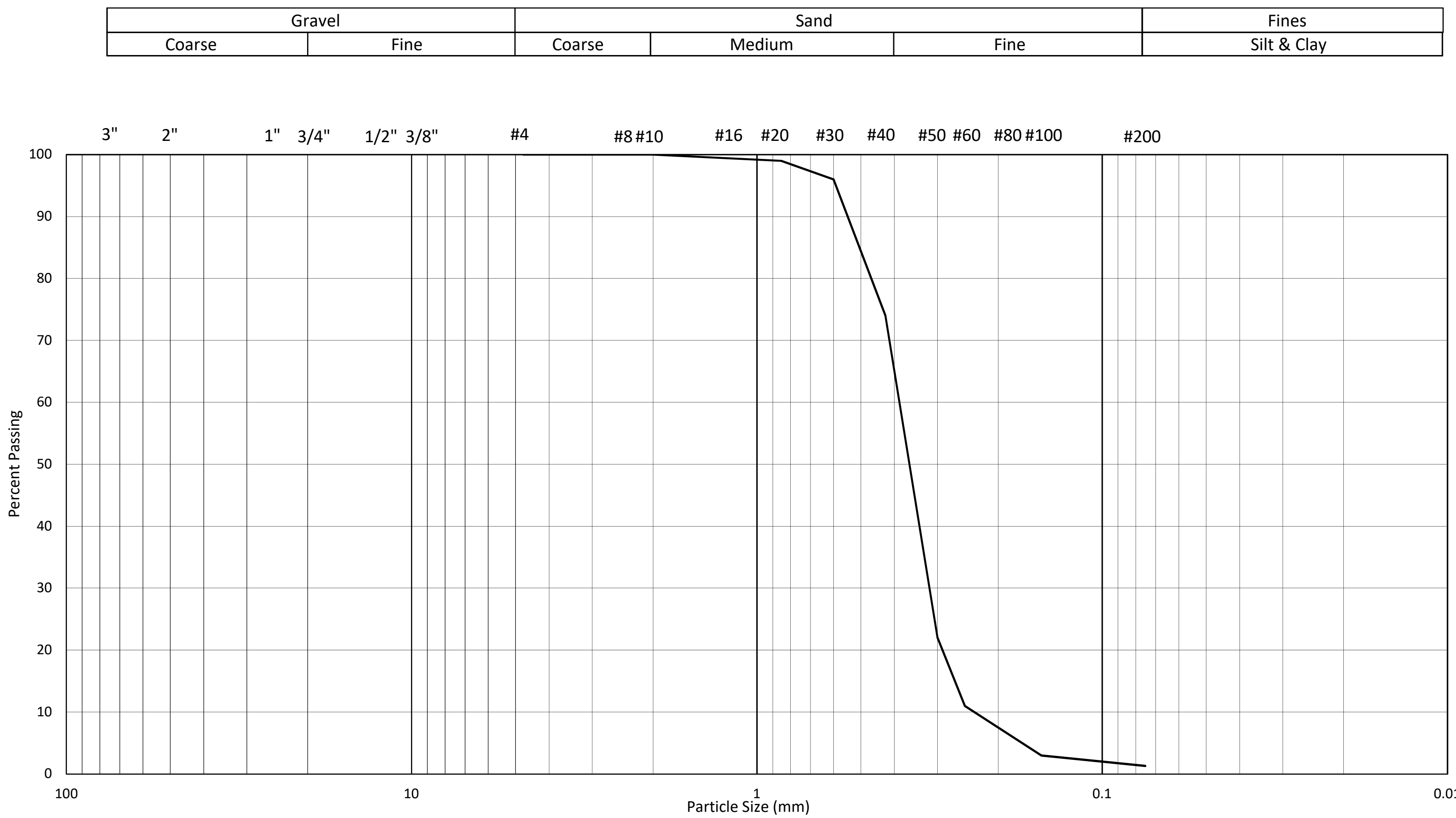
Dispersion Apparatus: Shaking

General

Results: The test is for informational purposes.

See Gradation G-01.pdf in the documents section at the end of this report.

Grain Size Accumulation Curve (ASTM)



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Project Number	B1907847	Gravel	0.0			Classification
Sample Number	G-01	Sand	98.7			
Boring Number	ST-3	Silt & Clay	1.3			Brown Poorly Graded Sand (SP)
Depth	20	D60=	0.3910	Cu=	1.6	
		D30=	0.3190	Cc=	1.1	
		D10=	0.2380			

Division of Industry Services
PO Box 2658
Madison, Wisconsin

Attachment 2:

SOIL AND SITE EVALUATION - STORM

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

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent of slope, scale or dimensions, north arrow, and BM reference to nearest road.	County La Crosse
Please print all information	Parcel I.D. 17-10289-40
Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]	Reviewed by: Date:

Property Owner: Stizo Development, LLC	Property Location Govt. Lot SW¼ NE¼ S29 T07 R16 W		
Property Owner's Mailing Address: PO Box 609	Lot	Block #	Subd. Name or CSM #
City, State Zip La Crosse, WI 54602	Phone Number	☒ City ☐ Village ☐ Town La Crosse	Nearest Road Saint Andrew Street

Drainage Area ______________ ☐ sq. ft. ☐ acres Test site suitable for (check all that apply): ☐ Bio-retention; ☐ Subsurface Dispersal System; ☐ Reuse; ☐ Irrigation ☒ Other	Hydraulic Application Test Method ☒ Morphological Evaluation ☐ Double Ring Infiltrometer Other: (specify)	Soil Moisture Date of soil Borings: July 30, 2019 USDA-NRCS WETS Value: ☐ Dry = 1; ☒ Normal = 2; ☒ Wet = 3.

ST-2 #OBS ☐ Pit ☒ Boring Ground surface Elevation 647.8 ft. Elevation of limiting factor 12 ft.

Horizon	Depth In.	Dominate Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr.
FILL	0 - 25	10YR 3/2	---	f.sl	0.sg.f	ml	c	0	< 20	0.50
FILL	25 - 36	10YR 3/3	---	f.ls	0.sg.f	ml	a	0	< 10	0.50
FILL	36 - 204	2.5Y 7/6	---	f.s	0.sg.f	ml	c	10	< 5	0.50
C	204 - 372	10YR 5/3	---	c.s	0.sg.c	ml	c	10	< 5	3.60

Comments: Groundwater was encountered at 12 feet while drilling and is a limiting layer. Seasonal and annual fluctuations of groundwater should also be anticipated.

ST-3 #OBS ☐ Pit ☒ Boring Ground surface Elevation 647.7 ft. Elevation of limiting factor 12 ft.

Horizon	Depth In.	Dominate Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr.
FILL	0 - 8	10YR 3/2	---	f.sl	0.sg.f	ml	c	0	< 20	0.50
FILL	8 - 144	10YR 4/4	---	f.s	0.sg.f	ml	g	0	< 5	0.50
FILL	144 - 204	10YR 4/1	---	f.ls	0.sg.f	ml	g	0	< 10	0.50
C	204 - 372	10YR 5/3	---	m.s	0.sg.m	ml	g	0	< 5	3.60

Comments: Groundwater was encountered at 12 feet while drilling and is a limiting layer. Seasonal and annual fluctuations of groundwater should also be anticipated.

Name: Benjamin R. Sullivan	Signature: Ben Sullivan	Credential Number: 1324025
Address: 2309 Palace Street, La Crosse, WI	Date of Evaluation: 8/2/2019	Phone Number: 608.781.7277

ST-5 #OBS ☐ Pit ☒ Boring Ground surface Elevation 647.6 ft. Elevation of limiting factor 9 ½ ft.

Horizon	Depth In.	Dominate Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr.
FILL	0 - 22	10YR 3/2	---	f.sl	0.sg.f	ml	c	0	< 20	0.50
FILL	22 - 72	10YR 4/4	---	f.ls	0.sg.f	ml	g	15	< 10	0.50
FILL	72 - 120	10YR 4/4	---	f.s	0.sg.f	ml	g	0	< 5	0.50
C	120 - 192	10YR 4/3	---	f.s	0.sg.f	ml	g	0	< 5	0.50

Comments: Groundwater was encountered at 9 ½ feet while drilling and is a limiting layer. Seasonal and annual fluctuations of groundwater should also be anticipated.

ST-6 #OBS ☐ Pit ☒ Boring Ground surface Elevation 647.9 ft. Elevation of limiting factor 10 ft.

Horizon	Depth In.	Dominate Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr.
FILL	0 - 26	10YR 3/2	---	f.sl	0.sg.f	ml	c	0	< 20	0.50
FILL	26 - 48	10YR 5/4	---	f.s	0.sg.f	ml	g	0	< 5	0.50
FILL	48 - 96	10YR 5/3	---	f.s	0.sg.f	ml	g	0	< 5	0.50
C	96 - 192	10YR 5/6	---	f.s	0.sg.f	ml	g	0	< 5	0.50

Comments: Groundwater was encountered at 10 feet while drilling and is a limiting layer. Seasonal and annual fluctuations of groundwater should also be anticipated.

Overall Site Comments: The site contains deep fills that consist of sandy soils. Groundwater was encountered at depths of 9 ½ to 12 feet across the site.