ADDENDUM NUMBER TWO
TO THE REQUEST FOR QUALIFICATIONS FOR DESIGN PROFESSIONAL SERVICES
LAKE COUNTY BOARD OF COMMISSIONERS AND LAKE COUNTY SHERIFF'S OFFICE
ISSUED AUGUST 23, 2024

The County hereby amends the Request for Qualifications as follows:

1. The County received the following requests for information and responds to each below:

RFI No. 1: Will the Geotechnical Engineering report by SME be issued to the special inspection firms?

Response: Yes, please see attached.

RFI No. 2: RFQ Page 9, 3.3 A

a. Does this project require pre/post-tension cables?

Response: No.

RFI No. 3: RFQ Page 9, 3.3 B

a. Reinforcing bar welding. Is there expected to be a need for welding of reinforcing bar, if so is please verify weldability testing is required.

Response: Yes, weldable deformed bars at slab edge bent plates, periodic inspection required.

RFI No. 4: RFQ Page 9, 3.3 C-E

a. What type of post installed anchors are expected to be used for this project?

Response: A combination of mechanical expansion/sleeve/screw anchors and adhesive anchors. Anchors to be installed into concrete and masonry.

RFI No. 5: RFQ Page 10, 3.3 G -I

a. What is the break schedule specification for concrete compressive strength cylinders?

Response: 1 at 7 days. 2 at 28 days, save 1 for 56 days if required.

b. How many cylinders will be required per set?

Response: 4 cylinders per set

c. Is shotcrete expected to be used on this project?

Response: No

RFI No. 6: RFQ Page 11, 3.4, 3

a. What specification will be used for Visual Stability Index?

Response: N/A, no self-consolidating concrete

RFI No. 7: RFQ Page 11, 3.5

a. As SME will be contracted for all soils work, does this include proofrolls, density testing, and aggregate base inspections for asphaltic concrete pavements and civil members?

Response: We believe this is correct but will finalize so there are no gaps once a testing and inspections consultant is retained.

b. Will SME be contracted with the entirety of foundation inspections including dimensions, reinforcing steel, and concrete?

Response: No. reviewing of reinforcing steel and its' placement along with concrete testing is a part of the testing and inspections scope of work. All the Geotechnical engineer will do is review soil conditions and proof rolling.

RFI No. 8: RFQ Page 14, 3.8 - Firestopping

a. What percentage of penetration and joints are required to be inspected?

Response: You will be required to meet ASTM 2174 (minimum 10% of penetrations, minimum 5% of the linear feet for joints)

RFI No. 9: RFQ Page 15, B, 4 – Agency has no authority to stop work.

a. Our firm's policy is to give all employees the ability to stop work when unsafe conditions or potential for injury is immediate. Please elaborate on this policy.

Response: We believe this is correct but will finalize so there are no gaps once a testing and inspections consultant is retained.

RFI No. 10: RFQ Page 20, Other Project Requirements

a. Visual observation of roofing construction

i. Will this observation take place in the presence of the manufacturer with the special inspections firm as the 3rd party?

Response: Yes

b. Asphalt Paving – Density Testing

i. Will in place nuclear density testing be sufficient for density readings?

Response: This can be discussed after a firm is selected and prior to requesting pricing proposals. Please NOTE: This is just an RFQ and not an RFP.

ii. Will coring or sampling and laboratory testing be required?

Response: This can be discussed after a firm is selected and prior to requesting pricing proposals. Please NOTE: This is just an RFQ and not an RFP.

GEOTECHNICAL EVALUATION REPORT

LAKE COUNTY OHIO PUBLIC SAFETY CENTER (LCOPSC)
PAINESVILLE, OHIO

SME Project Number: 093528.00
October 20, 2023

SME

SME

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October 20, 2023

Mr. Jason Boyd
County Administrator
Lake County Board of Commissioners
105 Main Street
Painesville, Ohio 44077

Via E-mail: jason.boyd@lakecountyohop.gov

RE: Geotechnical Evaluation
Lake County Ohio Public Safety Center (LCOPSC)
Painesville, Ohio
SME Project No. 093528.00

Dear Mr. Boyd:

We have completed our geotechnical evaluation for the Lake County Ohio Public Safety Center project. This report presents the results of our observations and analyses, our geotechnical and pavement engineering recommendations, and general construction considerations based on the information disclosed by the borings.

We appreciate the opportunity to be of service. If you have questions or require additional information, please contact me.

Sincerely,

SME

Brendan Lieske

Brendan P. Lieske, PE
Project Manager

Enclosure: SME Geotechnical Evaluation Report, Dated October 20, 2023

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APPENDIX A

APPENDIX B

1. INTRODUCTION

This report presents the results of our geotechnical evaluation for the proposed Lake County Ohio Public Safety Center project in Painesville, Ohio. We conducted this evaluation in general accordance with the scope of services outlined in SME Proposal P02311.23 dated August 11, 2023 and Change Order No. 1 dated September 22, 2023. Please refer to the referenced proposal and change order for information regarding our specific scope of services. Lake County administrator Jason Boyd authorized our services.

To assist with our evaluation of the proposed project and to help with the preparation of this report, SME was provided with an untitled and undated site concept drawing. In addition, SME attended project team meetings to discuss the details of the project.

1.1 SITE CONDITIONS

The project site is located at 125 East Erie Street in Painesville, Ohio. The general location of the site is depicted on the Location Map inset on the Boring Location Diagram (Figure No. 1) included in Appendix A of this report. The site currently consists of the existing Lake County Annex Building, which is a single-story building with a walkout basement surrounded by surface parking lots. The project site also includes parcels at the west and north corners of East Erie Street and North Saint Clair Street, which currently consist of vacant single-story structures. The ground surface on the site varies from approximately elevation 669 feet at East Erie Street down to about elevation 656 feet at the west end of the existing annex building.

1.2 PROJECT DESCRIPTION

The project will consist of the construction of a corrections facility, which will include Sherriff's administration offices. The building will be surrounded with new surface parking lots. Due to the anticipated Design-Build nature of this project, specific project details are not yet available. However, we understand the new facility will have multiple stories with a walkout basement level facing west, similar to the existing building. The basement level finished floor elevation (FFE) is proposed to be at 656 feet based on a project team meeting on October 11, 2023. Based on the RFQ, we assume maximum column loads of 450 kips and maximum wall loads of 8 kips per linear foot.

New pavement areas included in the project will consist of asphalt surfaced parking lots and drives throughout the development. The parking lots will include up to about 850 parking stalls. We anticipate the pavements will be trafficked primarily by passenger vehicles, with the drives being subjected to delivery vehicles and refuse trucks in addition to passenger vehicles. Grading plans were not provided to SME for use in our report. However, based on the provided information and existing site constraints (e.g., adjacent roads), we anticipate minimal cuts and fills of 2 feet or less will be required to establish design subgrade levels in pavement areas.

Stormwater control for the site is anticipated to include an underground detention system below the pavements at the parking lot along Jackson Street (near borings B9, B10, and B11). The detention system will have a footprint of about 20,000 square feet. We assume the anticipated infiltration depth is about 4 to 6 feet below the pavement surface at an elevation of about 650 to 652 feet.

The recommendations of this report are based on the information provided above and the results of the field evaluation. Contact SME if the final design information is different than discussed herein.

2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

SME performed 22 borings (B1 through B22) and 12 dynamic cone penetrometer (DCP) tests (located at B9 through B14, B16 through B19, B21 and B22) at the project site on August 24 through August 25, 2023. The approximate as-drilled boring locations are depicted on Figure No. 1. SME determined the number, depths, and locations of the borings based on the project information provided to us. SME staked or marked the borings in the field and estimated the existing ground surface elevations at the boring locations using the GPS unit with sub-foot accuracy.

2.1.1 BORINGS

Borings were advanced with a rotary drill rig using continuous-flight augers to the termination depths of the borings to facilitate the collection of soil samples. The borings included soil sampling based upon the Split-Barrel Sampling procedure. Rock coring was performed at select locations using an NQ sized core barrel. Soil and rock samples recovered from the field exploration were delivered to our laboratory for further observation and laboratory testing.

Groundwater level observations were recorded during and after completion of drilling and sampling. After recording groundwater level observations, the boreholes were backfilled with auger cuttings. Borings performed within existing pavement areas were patched with asphalt cold patch. Therefore, long-term groundwater levels are not available from the borings.

2.1.2 DYNAMIC CONE PENETROMETER (DCP) TESTING

A U.S. Army Corp of Engineers (USACE) DCP test was conducted at 12 boring locations (B9 through B14, B16 through B19, B21, and B22) to estimate the in-situ California Bearing Ratio (CBR) of the existing subgrade. CBR is an index commonly used in pavement design that gives an indication of subgrade support characteristics. The USACE DCP tests extended to a depth of about 3 feet below the existing pavement or ground surface. The USACE DCP consists of a 5/8-inch-diameter steel rod with an attached steel cone tip that is driven into the subgrade by means of a sliding, dual-mass hammer. The rate of cone penetration per blow is computed at selected penetration depths or hammer drop intervals. The USACE has developed relationships to estimate the in-situ CBR value from the results of the USACE DCP test. Soil strength with depth profiles were developed for each USACE DCP test location and are shown on the USACE DCP Data sheets included in Appendix A.

Table 1 below provides a summary of our opinion of the aggregate base and subgrade layer support conditions for various ranges of estimated in-situ CBR values based on the USACE DCP test results.

TABLE 1: SUBGRADE SUPPORT CONDITIONS

SUPPORT CONDITIONS	IN-SITU CBR RANGE FOR AGGREGATE BASE MATERIAL (%)	IN-SITU CBR RANGE FOR SUBGRADE SOILS (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

2.2 LABORATORY TESTING

The laboratory testing program consisted of visual soil classification (in general accordance with ASTM D-2488) of the recovered samples and moisture content and hand penetrometer testing of portions of the cohesive samples obtained. Atterberg limits tests and grain size analyses were performed on select soil samples. Point load testing and compressive strength testing was performed on select rock core samples. The Laboratory Testing Procedures document included in Appendix B provide descriptions of the laboratory tests performed. Based on the laboratory testing, we prepared a soil description and assigned a group symbol to the various soil strata encountered based on the Unified Soil Classification System (USCS).

Upon completion of the laboratory testing, boring logs were prepared which include information on materials encountered, the soil descriptions, penetration resistances, pertinent field observations made during the operations, and the results of the laboratory testing. The boring logs also include existing ground surface elevations at each boring location as estimated by SME. The boring logs and laboratory test reports are included in Appendix A. Explanations of symbols and terms used on the boring logs are provided on the attached Boring Log Terminology sheet.

Soil samples are normally retained in our laboratory for 60 days and then disposed, unless instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

The borings were typically performed in areas covered with topsoil or pavement. The surficial material thickness measurements reported on the boring logs should be considered approximate since mixing of these materials can occur in small diameter boreholes. Therefore, if more accurate surficial material thickness measurements are required, we recommend performing additional evaluations such as shallow test pits or hand augers for topsoil areas and pavement cores for pavement areas.

Below the surficial layer, the subsurface conditions consisted of existing fill soils at 12 of the 22 borings. The fills generally consisted of sands with varying quantities of debris (e.g., brick, cinders, slag) encountered within the fills at some locations. The sand fills were encountered in a very loose to dense condition. The fills extended to depths of about 3 to 5.5 feet below the existing grade, when encountered, corresponding to elevations between approximately 650.5 to 663.2 feet. It is sometimes difficult to distinguish between fill and natural soils based on samples and cutting from small-diameter boreholes, especially when the fill does not contain man-made materials, debris, topsoil or organic layers, and when the fill appears similar in composition to the local natural soils. Therefore, consider the delineation of fill described above and/or on the boring logs as approximate only. If needed, a more comprehensive evaluation of the extent and composition of the suspect fill could be made by reviewing former site topographic plans, aerial photographs, and other historical site records, along with observing test pit observations. Table 2 below summarizes the depths/elevations of fill material observed at the boring locations.

TABLE 2: SUMMARY OF EXTENT OF FILL MATERIAL

BORING NUMBER	EXTENDS TO APPROXIMATE DEPTH (FEET) (1)	EXTENDS TO APPROXIMATE ELEVATION (FEET) (2)
B1	Not Encountered	Not Encountered
B2	Not Encountered	Not Encountered
B3	3	653.1
B12	3	654.5
B13	Not Encountered	Not Encountered
B14	5.5	651.3

BORING NUMBER	EXTENDS TO APPROXIMATE DEPTH (FEET) (1)	EXTENDS TO APPROXIMATE ELEVATION (FEET) (2)
B4	3	655.6
B5	Not Encountered	Not Encountered
B6	Not Encountered	Not Encountered
B7	Not Encountered	Not Encountered
B8	5.5	660.8
B9	Not Encountered	Not Encountered
B10	5.5	650.5
B11	5.5	651.6

BORING NUMBER	EXTENDS TO APPROXIMATE DEPTH (FEET) (1)	EXTENDS TO APPROXIMATE ELEVATION (FEET) (2)
B15	3	656.8
B16	3	656.5
B17	5.5	655
B18	Not Encountered	Not Encountered
B19	5.5	663.2
B20	3	661.4
B21	Not Encountered	Not Encountered
B22	Not Encountered	Not Encountered

NOTES:

1. Refers to depth below existing ground surface.
2. Corresponding elevation based on estimated ground surface elevations referencing the NAVD 88 datum.

Below the fill strata and/or below the surficial layers at locations where fill soils were not observed, the subsurface conditions typically encountered sands to depths of about 8 to 23 feet below the existing ground surface, corresponding to elevations between approximately 643.3 to 651.7 feet. The sands were generally encountered in the very loose to dense condition. Lean clay was encountered below the natural sands. The clays were encountered with consistencies of medium to very stiff to depths of about 17 to 28.5 feet below the existing ground surface, corresponding to elevations between approximately 636.3 to 647.8 feet, prior to transitioning to very stiff to hard consistencies. Table 3 summarizes the Atterberg limits and sieve analysis test results. Table 4 summarizes the range of estimated densities for the soil profile strata, as requested by the Client.

TABLE 3: SUMMARY OF ATTERBERG LIMITS AND GRAIN SIZE TEST RESULTS

BORING NUMBER	SAMPLE NUMBER	LL	PL	PI	GRAVEL %	SAND %	FINES %
B3	SB3	-	-	-	1.8	94.2	3.9
B4	SB5	30	20	10	-	-	-
B5	SB5	28	18	10	-	-	-
B6	SB4	-	-	-	30.0	54.9	15.1
B6	SB6	28	19	9	-	-	-
B15	SB5	36	23	13	-	-	-
B16	SB2	-	-	-	5.0	79.9	15.1
B22	SB2	-	-	-	14.6	74.1	11.3

TABLE 4: ESTIMATED UNIT WEIGHT OF SOIL PROFILE STRATA

SOIL STRATUM	UNIT WEIGHT
Very Loose to Dense Sands	105 – 115
Medium to Stiff Lean Clay	120 – 135
Very Stiff to Hard Clay	135 – 145

Below the sand and clay soil profile, rock strata were encountered and confirmed by coring or conventional drilling at borings B3, B6, B7, B15, and B20. Sampler refusal (possibly on rock) was encountered at borings B4, B5, and B8. Rock fragments and/or hard drilling was encountered in the lower profile at several other borings. The rock and/or boring refusal depths ranged from about 29.3 to 39 feet below the existing ground surface, corresponding to elevations of about 624.1 to 631.7 feet.

Table 5 summarizes the depths at which rock or refusal was encountered in the borings. Refusal can sometimes be encountered on “floaters” i.e., boulders or ledges within a matrix of soil, on very dense or hard soil, and not on rock strata. Based on the rock core and split-barrel sampling, the underlying rock consisted of either slightly weathered to weathered shale. Photographs of the recovered core specimens are shown below in Images 1 and 2. Please refer to the attached boring logs for additional information. For reference, the top of the core run is located in the upper left corner of the core box, while the termination of the core run is located near the lower right corner.

TABLE 5: SUMMARY OF ROCK DEPTHS

BORING NUMBER	APPROXIMATE TOP OF ROCK DEPTH (FEET) (1)(2)	APPROXIMATE TOP OF ROCK ELEVATION (FEET) (3)	BORING NUMBER	APPROXIMATE TOP OF ROCK DEPTH (FEET) (1)(2)	APPROXIMATE TOP OF ROCK ELEVATION (FEET) (3)
B1	Not Encountered	Not Encountered	B12	Not Encountered	Not Encountered
B2	Not Encountered	Not Encountered	B13	Not Encountered	Not Encountered
B3	32	624.1	B14	Not Encountered	Not Encountered
B4	29.3	629.3	B15	33	626.8
B5	29.5	628.9	B16	Not Encountered	Not Encountered
B6	33	631.7	B17	Not Encountered	Not Encountered
B7	34	629.7	B18	Not Encountered	Not Encountered
B8	39	627.3	B19	Not Encountered	Not Encountered
B9	Not Encountered	Not Encountered	B20	38	626.4
B10	Not Encountered	Not Encountered	B21	Not Encountered	Not Encountered
B11	Not Encountered	Not Encountered	B22	Not Encountered	Not Encountered

1. Refers to depth below existing ground surface.
2. Depth based on visual classification of samples and/or depth of sampler or auger refusal.
3. Corresponding elevation based on estimated ground surface elevations referencing the NAVD 88 datum.

IMAGE 1: B3 ROCK CORE (33.5 to 43.5 FEET)

IMAGE 2: B7 ROCK CORE (39 to 49 FEET)

The recoveries of the rock core samples obtained at borings B3 and B7 were about 100 percent. The calculated RQDs varied from about 25 to 78 percent, which corresponds to a rock quality of “very poor” to “good”. Please refer to the summary table below for additional information regarding core recoveries, RQDs, compressive strengths, and a general assessment of the quality of the encountered bedrock in the rock core samples.

TABLE 6: ROCK CORE RECOVERY, RQD, ROCK QUALITY, AND COMPRESSIVE STRENGTH

BORING NUMBER	SAMPLE DEPTH (FEET) (1)	RECOVERY (%)	RQD (%)	ROCK QUALITY	UNCONFINED COMPRESSIVE STRENGTH (PSI)
B3	33.5 – 38.5	100	25	Very Poor	2,560 – 6,750(2)
	38.5 – 43.5	100	52	Fair	2,270 – 6,400(2)
B7	39 - 44	100	78	Good	3,990
	44 - 49	100	45	Poor	3,410 – 4,430

NOTES:

1. Refers to depth below existing ground surface.
2. Converted axial strength from point load testing.

The soil and rock profile described in this report and included on the boring logs is a generalized description of the encountered conditions. The stratification depths described in this report and shown on the logs indicate a zone of transition from one soil and/or rock type to another. They are not intended to delineate exact depths of change between soil and/or rock types. Soil and/or rock conditions may vary between or away from the exploration locations. Please refer to the boring logs for the soil descriptions, rock descriptions, and results of the field and laboratory tests at the specific exploration locations.

3.2 GROUNDWATER CONDITIONS

Groundwater was encountered in 13 of the 22 borings (B1 through B11, B14, and B15) during and/or upon completion of drilling operations at depths ranging from about 5.5 to 29 feet below the existing ground surface, corresponding to approximately elevations 630.8 to 653.1 feet. After pulling the augers, approximately 15 minutes after drilling, groundwater was encountered in 8 of the 22 borings (B1, B2, B4, B5, B6, B9, B10, and B11) at depths ranging from about 8.5 to 22 feet below the existing ground surface, corresponding to approximately elevations 636.4 to 648.5 feet. Groundwater was not encountered at the remaining borings locations during or upon completion of the drilling operations.

In cohesive soils (i.e., clays and silts), a long time may be required for the groundwater level in the borehole to reach an equilibrium position. Therefore, the use of groundwater observation wells (piezometers) is necessary to accurately determine the hydrostatic groundwater level within cohesive soils such as encountered at this site.

Expect hydrostatic groundwater levels, perched groundwater, and the potential rate of infiltration into excavations to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels indicated by the borings represent conditions at the time the readings were observed. The actual groundwater levels at the time of construction may vary.

4. ANALYSIS AND RECOMMENDATIONS

4.1 SITE CONSIDERATIONS

4.1.1 EXISTING FILL CONSIDERATIONS

The existing sand fill encountered in the borings are considered undocumented since we are not aware of records documenting the placement and compaction of it. The sand fill was generally in a very loose to dense condition. Much of the fill will be removed during excavations for the basement level to an FFE of 656 feet. Based on the condition of the fill encountered in the boring, we believe the existing fill can be considered for support of floor slabs (but not foundations), provided the subgrade soils are evaluated and prepared, as described below, prior to floor slab construction. Based on the condition of the existing fill encountered in the borings and the proposed type of construction, we believe the existing fill can remain below the floor slabs, provided:

- The subgrade is properly evaluated by SME and prepared as described in Section 4.
- Unsuitable fill is undercut and replaced with engineered fill.
- Very loose soils are improvement in-place or removed.
- The Owner accepts the associated risks described below.

The increased risks associated with supporting slabs over the existing fill at this site could include greater than typical post-construction settlement, resulting in differential movements and associated cracking of the slabs. These risks can be reduced, but not eliminated, if SME further evaluates the existing fill at floor slab subgrades. If the risks described above are not acceptable to the Owner, the existing fill should be completely removed from within the proposed building footprint and replaced with engineered fill.

If the existing fill will remain in-place for support of floor slabs, further evaluation of the existing fill during construction must be conducted by SME. Further evaluation should include observing the condition of the fill in hand-auger borings or shallow test pits, testing the fill using a dynamic cone penetrometer (DCP), observing the condition of the fill in the sides of the foundation excavations, and observing the response of the surface of the fill when subjected to a proofroll. Existing fill to remain in-place should be of sufficient strength and free of deleterious materials, such as excessive debris and organics. Unsuitable existing fill that cannot be improved in-place should be removed (i.e., undercut) and replaced with engineered fill that is placed and compacted per the requirements outlined in Section 4.2.4 of this report.

The recommendations provided in the following report sections are based on the assumption that suitable existing fill will remain in-place and be used to support the floor slabs and foundations will be supported on a ground improvement system as described in Section 4.2. If the Owner does not accept the stated assumptions and risks, please contact SME for revised recommendations.

4.1.2 VERY LOOSE SAND CONSIDERATIONS

Very loose to loose sands were encountered in the borings. The overly loose sands are expected to be able to be densified in-place to provide adequate support for floor slabs. However, typical densification methods (e.g., proof rolling or utilizing a vibratory roller at the surface) are not expected to improve the sands to a sufficient depth to provide suitable support of foundations.

Feasible options to remediate the very loose sands beneath foundations include performing a ground improvement method (aggregate piers or rigid inclusions) to improve the existing sands, removing/undercutting and replacement of existing loose sand with engineered fill, or utilizing a deep foundation system. For removal and replacement, it may be feasible to remove a portion of unsuitable existing soils, compact the base of the resulting excavation, and replace the excavated soil as engineered fill. Of these options, we recommend utilizing a ground improvement method, which is discussed further below. If requested, SME can discuss potential alternatives further.

1. Perform a ground improvement method to improve the existing fill soils for foundation support. Some potential advantages and disadvantages of this option include:
    a. An increased net allowable bearing capacity of between 3,000 and 6,000 pounds per square foot (psf) for foundation design.
    b. Limits the disposal volume of soils unsuitable for reuse as engineered fill (depending on ability to moisture condition at the time of construction) compared to the undercut and replacement option, as the recommended methods will produce limited amounts of spoils.
    c. Limits the imported fill volume compared to the undercut and replacement option.
    d. Limits/eliminates the necessity of dewatering compared to the undercut and replacement option.
    e. Eliminates the necessity of potential earth retention systems (ERS) and underpinning compared to the undercut and replacement option.

f. Shorten the construction schedule compared to the undercut and replacement option.

g. Uses proprietary systems and requires a specialty contractor to construct.

h. Is typically a cost effective alternative to traditional deep foundations.

4.2 SITE PREPARATION AND EARTHWORK

The project and site present construction challenges that need to be properly considered prior to construction and properly managed during construction. Specific construction challenges include:

1. Working Platform for Contractor installing the Ground Improvement System. The contractor should establish one working platform to install the ground improvement elements. Also, a performance specification as discussed in Section 4.2.2 should be prepared by SME to address the working platform.
2. Below-Grade Obstructions. Although not encountered in the borings, below-grade obstructions (e.g., large debris) could be encountered during the ground improvement operations. Refer to Section 4.8 below for more information.

3. Extent of Ground Improvement Methods. SME recommends ground improvement elements be located beneath the building foundations only. They need not be installed beneath lightly-loaded auxiliary structures, such as screen walls, retaining walls, or guard shacks, nor are they needed beneath slabs-on-grade.

There are coordination items that need to be addressed prior to and during construction between the specialty contractor performing ground improvement and the general contractor. Therefore, it is imperative to retain SME for additional services during the design process to assist with the preparation of performance specifications related to geotechnical engineering recommendations discussed within this report and to attend meetings as necessary, and during construction to verify our recommendations are followed during construction.

The following recommendations are based on the use of ground improvement techniques to allow for construction of conventional shallow foundations supported on grade and surficial improving (e.g., in-place densification and/or undercutting and replacing) soils for floor slab support, as need.

4.2.1 SITE SUBGRADE PREPARATION

The proposed building addition area, along with other areas to receive engineered fill, must be cleared of existing pavements and other deleterious materials to expose the underlying subgrade soils. We recommend the clearing and stripping extend a minimum of 5 feet beyond the building areas. Remove existing foundations, utilities, and other below-grade structures from previous construction to expose suitable natural soils. Backfill the areas where obstructions are removed with engineered fill, which is placed in lifts and properly compacted. Unsuitable existing fill should be undercut and replaced with granular engineered fill. Exercise care when excavating near existing utilities to protect them from damage.

After stripping the site and removing deleterious materials, after cuts are made to design subgrade levels, the exposed subgrade needs to be uniformly compacted using large construction equipment as the upper soils are in a variable condition. Take care during compaction not to damage nearby existing structures and underground utilities. Soil conditions will be variable near the surface, but predominantly existing sand fill and natural sand soil conditions are expected, and we recommend using large, drum vibratory roller for the compaction operations. Where groundwater is encountered close to the design subgrade, compaction with vibratory equipment may result in subgrade disturbance. Where pumping occurs under dynamic loading, compact the area by dead-rolling.

After compacting the exposed subgrade, we recommend the subgrade be subjected to a comprehensive proof-rolling program in the presence of SME. The purpose of proof-rolling is to locate areas of unsuitably soft/loose or disturbed subgrade. We recommend proof-rolling be performed with a fully-loaded, tandem-axle dump truck or other pneumatic-tire construction equipment. Areas of unsuitable subgrade revealed during proof-rolling must be mechanically improved (compacted) in-place or removed and replaced with engineered fill. In areas not accessible to proof-rolling equipment, we recommend the exposed subgrade be evaluated by SME with hand-operated equipment such as dynamic cone penetrometers and hand augers.

The exposed subgrade soils are susceptible to disturbance. Areas of prepared subgrade may be protected from disturbance during construction by placing a layer of crushed aggregate over the subgrade. The contractor needs to remove or drain ponded surface water and grade the site to prevent surface water from draining toward, or ponding over the building footprint and other areas of prepared subgrade.

4.2.2 GROUND IMPROVEMENT METHODS

After site preparation is complete, a ground improvement method must be utilized to improve the very loose sand subgrade conditions for support of the building foundations. Several ground improvement options could be utilized for this site; however, aggregate pier methods appear to be the most feasible option. The diameter, spacing, and installation techniques are designed to provide for a composite soil/aggregate ground improvement and improve the overall subgrade modulus to control settlement (deformation).

For foundation support, based on our experience with similar structural loads and soil conditions, we believe aggregate piers could achieve a maximum net allowable bearing pressure in the range of 4,000 to 8,000 psf. Significantly higher net allowable bearing pressures could be achieved, but may not be warranted based on the structural loads referenced in Section 1.2. If higher bearing pressures are needed, the ground improvement design could utilize closer pier spacing or grouted columns. The allowable bearing pressure achieved by the ground improvement technique is based on the size and spacing of the piers or columns. We recommend limiting total foundation settlement to less than 1-inch for foundations bearing on improved soils via a ground improvement method. At minimum, the piers will need to extend through the loose to very loose granular soils to bear on stiff to hard native clays below. Additionally, due to the site sands, in combination with groundwater, a dense-graded crushed aggregate or crushed concrete, rather than an open-graded material should be considered to reduce the risk of localized settlement due to migration of fines from the sands into the void spaces within the aggregate pier.

We recommend SME assist the design team in preparing a performance specification outlining the proposed treatment area, design bearing pressure the foundation subgrades must achieve, and maximum settlement criteria.

The invited specialty contractors should be asked for a submittal including their experience with similar projects; their proposed work plan; any modifications to the stated design criteria (such as allowing a higher design bearing pressure); a construction schedule; fees and unit rates that apply to installation of additional piers or columns; and fees associated with dealing with obstructions, delays, or other events beyond their control. After receiving the proposals, there may be a trade-off in pricing between contractors with a lower bid price, but offering a lower bearing pressure, and contractors with a somewhat higher bid price that can achieve a higher bearing pressure, thereby allowing a savings in foundation costs due to smaller footing sizes. There also may be schedule differences and other considerations between contractors to consider.

SME has significant experience with ground improvement methods using aggregate piers and is available to assist with preparing a performance specification, reviewing contractor submittals, conducting post bid interviews, and monitoring pier installation and load testing.

4.2.3 SUBGRADE PREPARATION FOR SLABS

As discussed in Section 4.2.1, the existing fill and natural sands are anticipated to have variable densities and very loose to loose zones should be expected. The exposed subgrade should be densified to provide suitable floor slab support.

We recommend the slab-on-grade subgrade soils be protected from frost action during winter construction. Frozen soils must be thawed and compacted, or removed and replaced prior to slab-on-grade construction. Prior to concrete placement for slabs, the subgrade needs to again be observed and tested to identify areas of subgrade that were disturbed during construction activities and to verify subgrade conditions are suitable for slab support. We recommend proof-rolling the final subgrade. If proof-rolling is not feasible because of access constraints, SME must observe and test the exposed subgrade using density in-place meters and/or other hand-operated equipment such as hand augers and cone penetrometers. Unsuitable subgrade indicated by SME needs to be removed and replaced with engineered fill or chemical modification could also be considered.

We recommend providing a minimum 6-inch thick slab subbase consisting of either #8 or #9 crushed aggregate or coarse sand to provide a leveling surface for construction of slabs, and a moisture capillary break between the slabs and the underlying soils. The thickness of the aggregate may need to be increased based on the floor loads for the slabs and to protect the subgrade from disturbance during construction. When determining the aggregate thickness, consider the time of year, the condition of subgrade soils during construction, and the type and volume of construction equipment to traffic the prepared subgrade. The aggregate must also be compacted per Section 4.1.4 of this report.

We recommend a subgrade modulus (k_{30}) of 200 pounds per square inch (psi) per inch be used to design slabs supported on properly prepared subgrade and subbase course as described above. The recommended subgrade modulus k_{30} is based on correlations with soil type developed from plate load tests conducted using a 30-inch diameter plate with 0.05-inches of deflection.

Floor slabs need to be separated by isolation joints from structural walls and columns bearing on their own foundations to permit relative movement. A minimum of 6-inches of engineered fill is recommended between the bottom of the slab and the top of the shallow spread foundation below.

We recommend a vapor retarder be provided below the floor slab if the slab is to receive an impermeable floor finish/seal or a floor covering which would act as a vapor barrier. The location of the vapor retarder (relative to the subbase) should be determined by the Architect/Engineer based on the intended floor usage, planned finishes, and in accordance with ACI recommendations.

4.2.4 ENGINEERED FILL REQUIREMENTS

Fill placed within the construction area must be free of frozen soil, organics, shale, slag, construction debris, particle sizes that will hinder compaction, or other deleterious materials. The fill for floor slabs and pavements must be spread in level layers not exceeding 9 inches in loose thickness and be compacted to a minimum of 98 percent of the maximum dry density as determined in accordance with the standard Proctor test. Sand fill should be compacted with a smooth drum vibratory roller or vibratory plate compactors including either walk-behind types, or plate compactors mounted on a backhoe or excavator (hoe-pac). Clay fill should be compacted using a sheepsfoot roller at a moisture content ranging from 2 percent above or below the optimum moisture content.

Based on information from the borings, we anticipate the natural sands and some of the existing fill should generally be suitable for reuse as engineered fill, provided they meet the general requirements listed in the previous paragraph.

Clays and sands with a significant amount of clays and/or silts (e.g., identified with a USCS Group Symbol of “CL”, “SC”, “SM”,), will be difficult to compact using smaller hand-operated compaction equipment and are not expected to be suitable for reuse as backfill for foundation excavations or utility trenches. These clayey and silty soils should also not be used as fill in areas where drainage is required.

In cases where the contractor must compact clayey and/or silty subgrade soils, it may be necessary to moisture condition the soil. Moisture conditioning is more easily performed during the warmer, drier summer months and may not be feasible during cold or wet times of the year.

The need for or extent of moisture conditioning or chemical modification of the soil to allow proper compaction can be affected by seasonal weather conditions at the time earthwork operations are performed, and the condition of the site soils. The project specifications should include provisions for moisture conditioning of soils to be placed and compacted on-site as engineered fill or chemical modification. Contractors should anticipate the need for moisture conditioning or chemical modification to allow for proper compaction and structure their construction bids accordingly.

Backfill in structural areas, utility trenches, and other confined areas where compaction is accomplished primarily by smaller, walk-behind plate compaction equipment, should consist of an approved granular material. We recommend using open-graded granular fill material, such as AASHTO No. 57 crushed aggregate, in and around areas where drainage is required. ODOT No. 304 crushed aggregate may be used where drainage is not required. Thinner lifts may be required in confined spaces to achieve compaction of the backfill.

4.3 FOUNDATIONS

4.3.1 SUBGRADE VERIFICATION

To verify the subgrade exposed at the foundation bearing surfaces is suitable for the maximum net allowable soil bearing pressure, and to verify necessary improvements at or below the foundation subgrade have been performed properly, foundation subgrades must be evaluated and tested during construction. The performance specifications for the ground improvement will include requirements for quality control and quality assurance (QC/QA) of the selected ground improvement method/contractor. By performing the geotechnical evaluation for this project, and preparing this geotechnical evaluation report, SME is the geotechnical engineer of record for this project and is best suited to monitor these QC/QA methods and verify the recommendations of this report, and the design requirements of this project, are in fact incorporated into the construction.

4.3.2 SHALLOW FOUNDATIONS

Shallow spread and continuous strip footings can be constructed to bear on soils improved using a ground improvement method(s). Recommendations regarding anticipated design bearing pressures after ground improvement are provided in Section 4.2.2. The final design bearing pressure should be determined in conjunction with the preparation of the performance specification for ground improvement and the selection of the ground improvement contractor.

Shallow foundations must be situated a minimum of 42 inches below final site grade in any unheated areas for protection against frost action during normal winters. Foundations in interior (heated) areas of the building can be designed at shallower bearing levels on suitable soils just below the grade slab. However, the contractor must protect the foundations and proposed bearing soils from freezing during construction if work occurs in the winter months, and as foundations must be in contact with the aggregate piers, the tops of the aggregate piers must be established at the higher bearing elevation.

For frost heave considerations, vertical excavation sidewalls must be maintained during foundation concrete placement and the side walls must not be allowed to “mushroom out” near the top. If vertical earthen sidewalls cannot be maintained, it will be necessary to slope back the foundation excavations and form foundation sidewalls to maintain vertical faces for foundations and reduce the potentially adverse effects resulting from frost heave. Based on the loose near-surface granular soils, we expect it will be necessary to over-excavate and form foundations, rather than place bank-formed foundations. Caved soils must be suitably removed from the foundation bearing surfaces before placing concrete.

For bearing capacity and settlement considerations, we recommend continuous (wall) foundations have a minimum width of 18 inches and column foundations have a minimum lateral dimension of 30 inches. In cases where structural loads are light, the minimum foundation size criteria may govern the size of the foundations and not the recommended allowable soil bearing pressure.

4.4 SEISMIC SITE CLASSIFICATION

Based on the subsurface information obtained from the borings drilled to a maximum depth of 49 feet, along with the specifications provided in the Ohio Building Code, Section 1613., a Site Classification of “D” applies to this site for structural seismic design.

Though a Site Classification of “D” has been determined, our experience with the region geology suggest that a better seismic site classification (i.e., Site Classification of “C”) could potentially be obtained. If the benefits of a higher seismic site class are significant, SME recommends performing a multi-channel analysis of surface waves (MASW) site evaluation to obtain shear wave velocities through the soil profile to further evaluate the seismic site class. SME could be retained to perform this evaluation upon request.

4.5 RETAINING WALLS

4.5.1 WALL FOUNDATIONS

The building is proposed to be constructed with below grade wall for the walk-out basement. These walls will bear on foundations over a ground improvement system, as provided in Section 4.2 of this report. The walls need to be designed to effectively support the overburden weight of soil backfill and additional lateral pressures due to surcharge loading; such as, anticipated floor or column loads, along with transient loads adjacent to the walls. Smaller walls may be required elsewhere on site, such as near loading docks or Sally ports. Retaining walls that do not support building loads need not be supported on aggregate piers.

4.5.2 WALL BACKFILL

We recommend the below-grade wall backfill immediately behind or against the wall (recommended to extend a minimum of 12 inches behind the wall) consist of an open-graded well-draining granular material (e.g., AASHTO #8 or #57 gradation) compacted as engineered fill. Do not use slag products or shale. To limit water infiltration into the granular backfill behind the wall, the upper one to two feet of the backfill should consist of compacted clay placed as engineered fill.

Drainage should be provided at the bottom of the wall backfill (see Section 4.5.4). The wall backfill should be placed in lifts and consolidated until no further densification is noted. Exercise care during compaction of the wall backfill to avoid overstressing the walls. If required, walls must be designed to accommodate the additional stresses associated with operating compaction equipment adjacent to the wall.

4.5.3 LATERAL EARTH PRESSURES AND SLIDING RESISTANCE

Provided an open-graded granular material is used as backfill, a unit weight of 120 pounds per cubic foot (pcf) and a friction angle of 33 degrees can be considered for design purposes. The walls are expected to be rigid walls or restrained so they do not rotate sufficiently to permit the lower active earth pressure (K_a) condition to be reached. Therefore, an at-rest lateral earth pressure coefficient (K_0) of 0.45 and an equivalent fluid at-rest pressure of 57 psf per foot of wall height is recommended for calculating the lateral earth pressures. This equivalent fluid pressure would increase linearly from 0 psf at the ground surface, to a maximum at the base of the wall.

Additional lateral pressures due to surcharge loading must be added to the above lateral earth pressures for design. Surcharge loads need to be modeled as a uniform pressure distribution applied to the entire wall height. We recommend using a horizontal coefficient for at-rest conditions, anticipating the below-grade walls will be held rigid, to calculate loads on walls due to surcharges.

Sliding or shear resistance along the base of wall foundations may also be used to resist horizontal loads. We recommend an ultimate coefficient of sliding friction of 0.3 for foundation design for foundations bearing on suitable natural sands, lean clays, or engineered fill overlying natural soils. Additionally, we recommend a minimum factor of safety of 1.5 for sliding stability or shear resistance.

4.5.4 DRAINAGE

The earth pressures presented above are for a drained wall backfill. To reduce the potential for the build-up of hydrostatic pressure behind the below-grade walls, we recommend foundation drains be installed along the sides of the walls retaining soil. The installation of a long-term drainage system is critical for the facility, as groundwater levels observed in the area could infiltrate the lower level depending on seasonal conditions, and the final design bearing level of the walls.

We recommend the foundation drains consist of a minimum six-inch diameter perforated plastic drain pipe, wrapped with a filter fabric (e.g., Mirafi® 140N or 160N) and surrounded by six inches of a filter material, such as AASHTO #8 or #57 gradation wrapped with a filter fabric. The drains need to be discharged into a gravity drainage outlet (or connected to a sump pump system if gravity drainage is impractical). We recommend the design include provisions for access to the drains for cleaning and maintenance (i.e., clean-outs). Roof downspouts must not be discharged onto the ground surface above the walls.

4.6 PRELIMINARY PAVEMENT RECOMMENDATIONS

4.6.1 INTRODUCTION

This section of the report includes our recommended section and construction recommendations for the proposed asphalt surfaced pavements at this site. We have developed the recommended pavement section and recommendations for subgrade preparation based on the information obtained from the borings, the results of the DCP tests, and project information discussed elsewhere in this report.

SME has not been provided with a final grading plan or detailed traffic information for the site at this time. Therefore, the pavement recommendations in this report are considered preliminary. The pavement section that we recommended is based on the traffic information described in Section 4.6.2. Please review the traffic information and contact SME if these are incorrect. Once a final grading plan is available and traffic information has been verified, contact SME so we can review our pavement recommendations and revise them if necessary.

Recommendations for a concrete pavement section were not requested. However, a concrete pavement section can offer improved resistance to point loads and for areas experiencing repeated turning actions of trucks and is typically beneficial for dumpster pads, entrance drive approaches, and building aprons. SME would be pleased to discuss options for concrete pavements at the site.

4.6.2 TRAFFIC

Traffic estimates for the pavements at this site were not provided to SME. We anticipate the site traffic will consist primarily of passenger vehicles. As noted in Section 1.2, the proposed parking lots will include a total of about 850 parking stalls. For pavement design purposes, we assumed the drives at the site will also be trafficked by delivery trucks and vans, passenger shuttle buses, and recycling and refuse haulers in addition to passenger vehicles. We assumed no semi-trailer truck traffic will occur at the site. Based on the traffic assumptions described above, we estimate up to about 100,000 Equivalent Single Axle Loads (ESALs) will occur over a 20-year period along the site drives, and approximately 50,000 ESALs will occur over a 20-year period in the car parking areas.

4.6.3 SUBGRADE PREPARATION FOR PAVEMENT AREAS

We recommend preparing the subgrade in accordance with Section 4.2.1 of this report. Earthwork and pavement construction must be performed in accordance with the 2023 ODOT Standard Specifications for Construction unless otherwise noted in this report.

Proper pavement subgrade preparation includes removing unsuitable fill and buried topsoil, uniformly compacting the exposed subgrade with appropriate compaction equipment, performing proofroll tests, undercutting overly soft/loose (and/or debris/organic-laden) subgrade, and replacing undercuts with suitable structural fill. On that basis, SME needs to assess the existing subgrade onsite at the time of construction. We recommend this occur on a case-by-case basis to address the specific needs of each situation. To address budgetary concerns, we recommend including a contingency for additional earthwork (e.g., undercutting, in-place compaction, removal of unsuitable fill, importing suitable fill, etc.) that may be required to improve subsurface conditions.

Based on the subsurface conditions encountered in the borings performed in the pavement areas (i.e., borings B9 through B14, B16 through B19, B21 and B22), we expect the exposed subgrade soils will primarily consist of natural sands or sand fill, except in the vicinity of boring B16, where a fill consisting of brick and limestone fragments was encountered. The existing fill at this site can be considered satisfactory for pavement support provided it is properly evaluated and prepared as described in Sections 4.1.1 and 4.2.1. However, undercutting should be anticipated in the vicinity of boring B16 where fill consisting of brick and limestone fragments was encountered in the upper 3 feet below the existing ground surface. Engineered fill placed in the pavement areas must meet the requirements of Section 4.2.4 of this report.

Grade the subgrade to provide flow of water out of the pavement system. We recommend the subgrade be graded similarly to the proposed pavement surface. The top 12 inches of the subgrade should be compacted to at least 100 percent of Standard Proctor. Proofroll the final subgrade surface with a fully loaded tandem axle dump truck. We recommend the criteria for the final proofroll be a maximum of 1/4 inch of deflection or rutting on the subgrade.

Once the subgrade is stable, we recommend the pavement section be placed soon thereafter to avoid further subgrade disturbance. If additional subgrade disturbance occurs prior to pavement placement, stabilize the disturbed areas by compaction in-place, placement of crushed aggregates, or other suitable methods.

4.6.4 RECOMMENDED PAVEMENT SECTION

The recommended section for the pavements at this site is shown in Table 7. This pavement section was developed based on our experience with similar applications and the AASHTO pavement design methodology to provide an estimated 20-year service life, based on the traffic estimates discussed in Section 4.6.2 in this report.

The recommended layer materials described refer to standard material designations listed in the 2023 ODOT Standard Specifications for Construction (dated July 21, 2023), unless otherwise modified in this report. Typical routine maintenance such as crack sealing, patching, and overlays should be anticipated and performed over the service life of the pavement system.

TABLE 7: PROPOSED ASPHALT PAVEMENT SECTION

LAYER	MATERIAL	THICKNESS (IN.)
Asphalt Surface Course	ODOT 441 – Type 1, Surface Course (1)	1.5
Asphalt Intermediate Course	ODOT 441 – Type 2, Intermediate Course (1)	2.5 (2)

LAYER	MATERIAL	THICKNESS (IN.)
Aggregate Base	ODOT 304 Crushed Limestone (3)	10.0

NOTES:

1. As modified in Section 4.6.5 – Asphalt Material Recommendations.
2. Intermediate course thickness may be reduced to 2.0 inches in passenger vehicle parking areas where delivery truck or refuse hauler traffic will not occur.
3. See Section 4.6.6 (Aggregate Base Material Recommendations) for material details.

The pavements at this site will experience relatively low heavy vehicle traffic and distress is anticipated to be related to thermal cracking and possibly some wheel denting in the parking stalls. Surface scuffing may be observed near the parking stalls during wheel movements of the vehicles, especially if the pavement is open to traffic soon after paving.

4.6.5 ASPHALT MATERIAL RECOMMENDATIONS

We recommend following the ODOT 2023 Standard Specifications for Construction as related to the proposed pavement construction except as modified herein. PG64-22 asphalt binder should be used in the production of the asphalt mixtures. The amount of Reclaimed Asphalt Pavement (RAP) shall be dictated by ODOT specifications and plant RAP processing certifications.

The asphalt mixture should be designed for target air voids of 3 percent and the in-place mix should be compacted to between 94 to 97 percent of the theoretical maximum density as determined per ASTM D2041 (Rice Method). We recommend a bond coat of SS-1h emulsion be required between asphalt pavement layers at a rate of 0.1 gallons/s.y. If a significant time elapses between the placement of subsequent pavement layers, the existing pavement surface should be evaluated, and the surface should be suitably cleaned to remove dust and debris prior to placing the bond coat.

4.6.6 AGGREGATE BASE MATERIAL RECOMMENDATIONS

For improved subsurface drainage, it would be necessary for the aggregate base to be free draining. This is not the case with most of the locally available ODOT item #304 crushed aggregate because of the high percentages of fine size particles allowed by the specification. If improved subsurface drainage is required, then we recommend that a restricted blend of 304 base material be used which is marketed as “modified 304” in order to provide the required permeability. The final blend used will fall within the broader ODOT #304 specification but restricts or limits the sizes used to produce a more drainable 304. The gradation of the base used should fall between the “Restricted Maximum” and the standard “304 Minimum” as shown in Table 8 and Image 3. Before any aggregate base materials are delivered to the site, they should be sampled at the source and the material approved in advance by the geotechnical engineer.

TABLE 8: RESTRICTED ODOT #304 CRUSHED AGGREGATE BASE

SIEVE	SIZE, mm	ODOT ITEM #304 SPECIFICATION		RESTRICTED ODOT ITEM #304 MAXIMUM
		MINIMUM	MAXIMUM	
2”	50.80	100	--	--
1”	25.00	70	100	**100**
¾”	19.00	50	90	**90**
½”	12.70	--	--	**75**
3/8”	9.50	--	--	**65**
No. 4	4.75	30	60	**40**
No. 30	0.60	9	33	**15**
No. 200	0.075	0	15	**6.0**

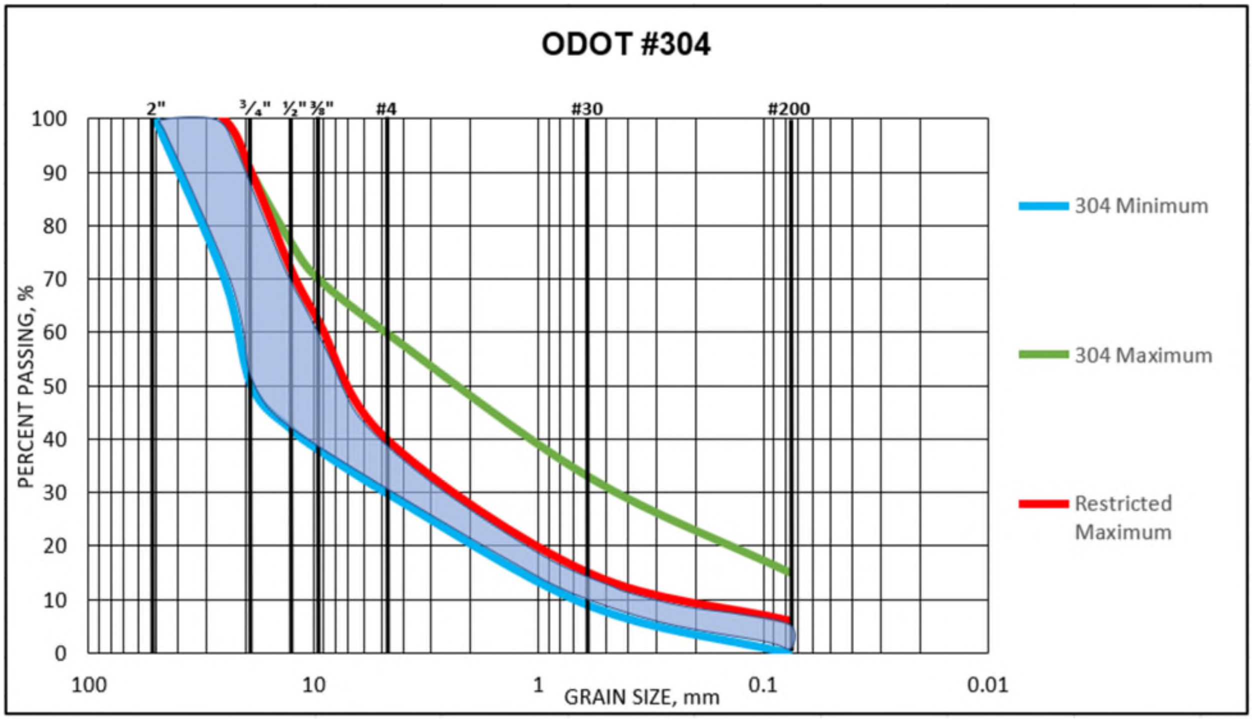

IMAGE 3: ODOT Item #304 and Restricted ODOT #304 Maximum

4.6.7 PAVEMENT DRAINAGE CONSIDERATIONS

The pavement system must be properly drained to reduce the possibility of frost heaving and softening of the subgrade due to water infiltrating through cracks. The infiltrated water, if not properly drained, is expected to adversely affect the pavement performance.

We recommend that the drives be constructed using a crowned section and curb inlets as opposed to inverted crown drainage with catch basins. A crowned section should improve removal of water from the pavement drive lane areas and provide better pavement performance. Catch basins within parking lots should have a minimum 25-foot long sections of underdrain installed in four directions perpendicular to each other to provide subsurface drainage. Curb inlets should have 25-foot long sections of underdrains installed along the curbs in both directions to provide subsurface drainage. Cutoff drains should be installed along the perimeter of the pavement where adjacent ground surface elevations slope towards the pavement. Other areas of strategically placed additional underdrains might also be beneficial at this site.

The drain trenches should be excavated to a minimum depth of 18 inches below the bottom of the aggregate base and should be at least 12-inches wide. The drains should consist of a minimum 6-inch-diameter, perforated, corrugated polyethylene drainpipe that is bedded and backfilled with ODOT #57 crushed limestone or washed gravel. The entire trench, including the bedding and backfill, should be wrapped in a non-woven geotextile fabric that is suitably overlapped on top. The trench should be backfilled to the proposed bottom elevation of the aggregate base.

4.6.8 GENERAL PAVEMENT CONSTRUCTION COMMENTS

We recommend the existing pavements at this facility be left in place until the building construction is completed.

Partial construction of the pavements and use of the intermediate course as a construction platform will likely result in premature damage that would require repairs prior to placing the final lift. The asphalt intermediate course is not strong enough to carry heavy construction traffic without damage occurring.

We recommend developing specific haul and delivery routes and preparing separate staging areas. In these areas, we recommend the asphalt intermediate course thickness be increased to minimize damage and placement of the final lift of asphalt be delayed until the majority of the construction activities have been completed. This action will allow repair of localized failure if any does occur.

As with any pavement, cracking is inevitable particularly due to thermal changes, trapped groundwater, and frost action. Cracking will occur, and some pavement repairs are expected, before reaching the design life of the pavement. Proper drainage, protection from oversized loads, and regular maintenance can help reduce the pavement distress. Routine maintenance such as crack sealing, joint sealing, and patching needs to be performed such that water infiltration and frost heave effects associated with the local climate are minimized.

4.7 STORM-WATER MANAGEMENT AREAS

Stormwater control for the site is anticipated to include an underground detention system below the pavements at the parking lot along Jackson Street (near borings B9 through B11). We assume the anticipated infiltration depth is about 4 to 6 feet below the pavement surface at an elevation of about 650 to 652 feet. Generally, natural and/or fill sands were encountered in these borings at the proposed infiltration elevation. Sands are anticipated to have a relatively high permeability and are generally considered favorable for infiltration. SME can perform additional infiltration testing at the design infiltration level to further evaluate the infiltration rates of the soils within the within detention system footprint.

Groundwater levels were observed in these borings at elevations of up to 649.1 feet. Groundwater depth/elevation should be considered when selecting the infiltration depth and evaluating the storage capacity of the detention system.

Furthermore, the system design should consider the potential for hydrostatic uplift forces on the underground elements. If uplift forces are anticipated on the system, tie-downs could be utilized to provided additional uplift resistance.

4.8 CONSTRUCTION CONSIDERATIONS

Groundwater seepage into foundation and utility excavations should be anticipated during construction for excavations extending below an elevation of about 654 feet. We anticipate standard sump pit and pump methods should generally be adequate to control groundwater on a localized and temporary basis for excavations that extend less than about 2 feet below the groundwater level. However, for excavations extending more than about 2 feet below the groundwater level, higher capacity dewatering techniques such as well-points or submersible pumps in slotted casings (well) may be required. If higher capacity dewatering methods are used, an evaluation of the potential effect of the anticipated groundwater drawdown on adjacent structures should be performed. A working surface of crushed aggregate may be required to protect the exposed subgrade where seepage is encountered.

The contractor should be prepared to remove obstructions as required during the ground improvement installation by pre-excavation or pre-drilling. Depending on the size, number, and location of the obstructions, this can be quite time consuming and labor intensive, and can require additional offsite disposal of soil and/or groundwater beyond simple obstruction removal. The project plans and specifications should include allowances for removing obstructions. The potential for encountering obstructions should be clearly indicated on project documents, and a line item for dealing with obstructions should be provided in the bid documents.

Exposed sand subgrade soils are susceptible to disturbance when overly dry and trafficked. Therefore, to reduce the potential of subgrade disturbance across the site, construction traffic should be restricted to staging areas, and should not randomly traffic the site.

The contractor must protect adjacent existing buildings, utilities, and roadways during construction of the proposed building and site improvements. During the excavating and compacting operations, excessive vibrations should not cause settlement of the existing buildings, utilities, and roadways, and the contractor should avoid undermining existing buildings, utilities, and roadways. Excavations should not extend below existing foundations without first properly underpinning or shoring the existing foundations. In areas where there is insufficient space to temporarily slope back excavations in accordance with applicable regulations, temporary earth retention systems will be required during construction. Underpinning, shoring and earth retention systems should be designed by a qualified professional engineer, and installed by a contractor experienced with construction of these systems.

The contractor must provide safely sloped excavations or an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, use appropriate shoring to resist the extra pressure due to the superimposed loads.

Handling, transportation, and disposal of excavated materials and groundwater should be performed in accordance with applicable environmental regulations.

5. SIGNATURES

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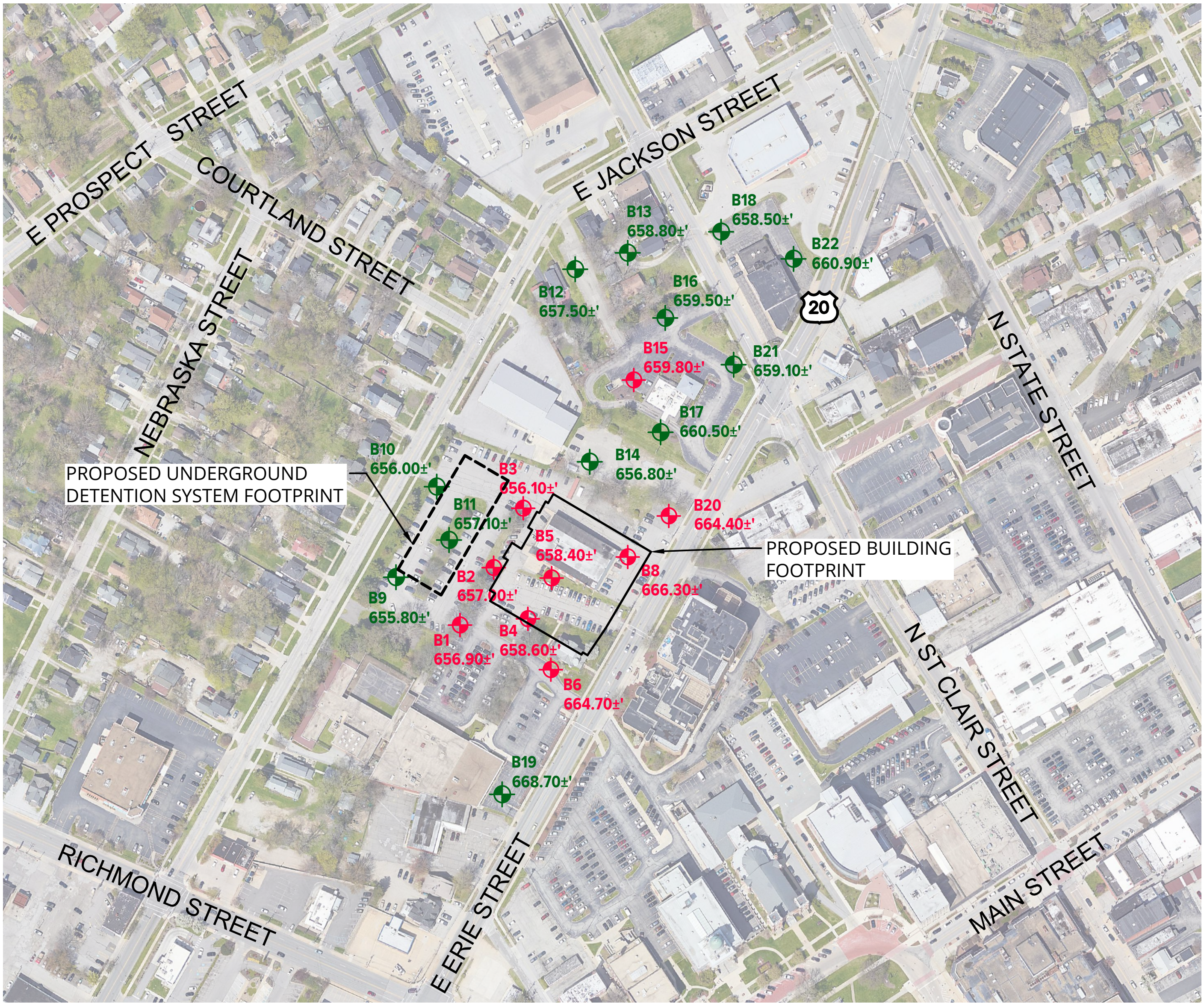
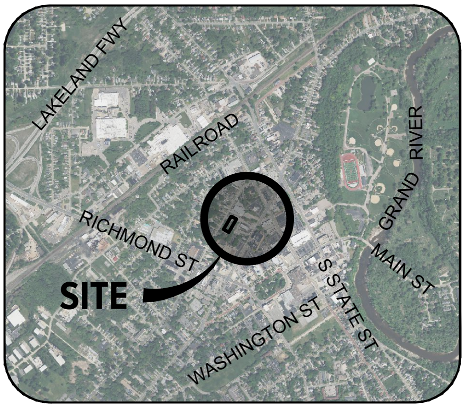
APPENDIX A

BORING LOCATION DIAGRAM (FIGURE NO. 1)
BORING LOG TERMINOLOGY
ODOT QUICK REFERENCE GUIDE FOR ROCK DESCRIPTION
ODOT STRENGTH OF BEDROCK
BORING LOGS (B1 THROUGH B22)
ROCK CORE PHOTO LOGS
USACE DCP DATA SHEETS (B9 THROUGH B14, B16 THROUGH B19, B21, AND B22)
LABORATORY TEST RESULTS





LOCATION MAP

NOT TO SCALE

LEGEND

⊕ APPROXIMATE BORING LOCATION

⊕ APPROXIMATE BORING/USACE DCP LOCATION

NOTE:
1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO WITH AN IMAGE DATE OF 04-27-2022.

0' 300' 600'

GRAPHIC SCALE: 1" = 300'

No.	Revision Date		
		Date	09-08-2023
		Drawn By	CRC
		Designed By	BAM
		Scale	AS NOTED
		Project	093528.00

BORING LOCATION DIAGRAM
LAKE COUNTY OHIO PUBLIC SAFETY CENTER (LCOPSC)
PAINESVILLE, OHIO

SME
www.sme-usa.com

Figure No. 1

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL
(more than 50% of material is larger than No. 200 sieve size.)

	Clean Gravel (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	▨	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)		
	▨	GM	Silty gravel; gravel-sand-silt mixtures
	▨	GC	Clayey gravel; gravel-sand-clay mixtures
	Clean Sand (Less than 5% fines)		
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	▨	SW	Well-graded sand; sand-gravel mixtures, little or no fines
	▨	SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)		
	▨	SM	Silty sand; sand-silt-gravel mixtures
	▨	SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL
(50% or more of material is smaller than No. 200 sieve size)

SILT AND CLAY Liquid limit less than 50%	▨	ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
	▨	CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
	🟩	OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater	▨	MH	Inorganic silt of high plasticity, elastic silt
	▨	CH	Inorganic clay of high plasticity, fat clay
	▨	OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL	▨	PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

■ Topsoil	□ Void	▨ Sandstone
▨ Asphalt Concrete	▨ Glacial Till	▨ Siltstone
▨ Aggregate Base	▨ Coal	▨ Limestone
▨ Portland Cement Concrete	▨ Shale	▨ Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}{}^{2}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}{}^{2}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……………………….……...GW, GP, SW, SP
More than 12 percent…………………….…..….GM, GC, SM, SC
5 to 12 percent…………….....……..Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

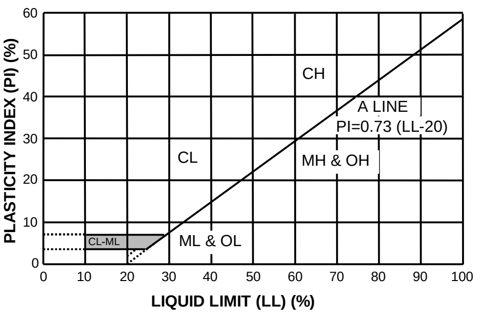
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressuremeter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

DESCRIPTION OF RELATIVE QUANTITIES

The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines:

Trace	–	particles are present but estimated to be less than 5%
Few	–	5 to 10%
Little	–	15 to 25%
Some	–	30 to 45%
Mostly	–	50 to 100%

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	**N_{60} (N-Value) (Blows per foot)**
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	Over 81

Cohesive Soils

Consistency	**N_{60} (N-Value) (Blows per foot)**	**Undrained Shear Strength (kips/ft^2)**
Very Soft	<2	0.25 or less
Soft	2 - 4	> 0.25 to 0.50
Medium	5 - 8	> 0.50 to 1.0
Stiff	9 - 15	> 1.0 to 2.0
Very Stiff	16 - 30	> 2.0 to 4.0
Hard	> 30	> 4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N60 values as reported on boring logs represent raw N-values corrected for hammer efficiency only.

APPENDIX A.2 – ODOT Quick Reference Guide for Rock Description

1: ROCK TYPE: Common rock types are: Claystone; Coal; Dolomite; Limestone; Sandstone; Siltstone; & Shale.

2: COLOR: To be determined when rock is wet. When using the GSA Color charts use only Name, not code.

3: WEATHERING

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alternation of the rock mass. Mineral crystals have a bright appearance with no discoloration. Fractures show little or no staining on surfaces.
Slightly weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering “halos” evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly weathered	Entire rock mass appears discolored and dull. Some pockets of slightly too moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present, but the material can generally be molded and crumbled by hand pressures.

4: TEXTURE

Component		Grain Diameter
Boulder		>12”
Cobble		3”-12”
Gravel		0.08”-3”
Sand	Coarse	0.02”-0.08”
	Medium	0.01”-0.02”
	Fine	0.005”-0.01”
	Very Fine	0.003”-0.005”

5: RELATIVE STRENGTH

Description	Field Parameter
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1 inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist’s pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼” deep can be excavated by hand blows of a geologist’s pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

6: BEDDING

Description	Thickness
Very Thick	>36”
Thick	18” – 36”
Medium	10” – 18”
Thin	2” – 10”
Very Thin	0.4” – 2”
Laminated	0.1” – 0.4”
Thinly Laminated	<0.1”

7: DESCRIPTORS

Arenaceous – sandy
Calcareous - contains calcium carbonate
Conglomeritic - contains rounded to subrounded gravel
Ferriferous – contains iron
Friable – easily broken down
Siliceous – contains silica

Argillaceous - clayey
Carbonaceous - contains carbon
Crystalline – contains crystalline structure
Fissile – thin planner partings
Micaceous – contains mica
Stylolitic – contain stylotites (suture like structure)

Brecciated – contains angular to subangular gravel
Cherty- contains chert fragments
Dolomitic- contains calcium/magnesium carbonate
Fossiliferous – contains fossils
Pyritic – contains pyrite
Vuggy – contains openings

APPENDIX A.2 – ODOT Quick Reference Guide for Rock Description

8: DISCONTINUITIES

a: Discontinuity Types

Type	Parameters
Fault	Fracture which expresses displacement parallel to the surface that does not result in a polished surface.
Joint	Planar fracture that does not express displacement. Generally occurs at regularly spaced intervals.
Shear	Fracture which expresses displacement parallel to the surface that results in polished surfaces or slickensides.
Bedding	A surface produced along a bedding plane.
Contact	A surface produced along a contact plane. (generally not seen in Ohio)

b: Degree of Fracturing

Description	Spacing
Unfractured	> 10 ft.
Intact	3 ft. – 10 ft.
Slightly fractured	1 ft. – 3 ft.
Moderately fractured	4 in. – 12 in.
Fractured	2 in. – 4 in.
Highly fractured	< 2 in.

c: Aperture Width

Description	Spacing
Open	> 0.2 in.
Narrow	0.05 in. - 0.2 in.
Tight	<0.05 in.

d: Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on the discontinuity surface.
Slightly Rough	Asperities on the discontinuity surface are distinguishable and can be felt.
Slickensided	Surface has a smooth, glassy finish with visual evidence of striation.

11: RECOVERY

$Run\ Recovery = \left(\frac{R_R}{L_R}\right) * 100$	$Unit\ Recovery = \left(\frac{R_U}{L_U}\right) * 100$
L_R = Run Length R_R – Run Recovery	L_U = Rock Unit Length R_U – Rock Unit Recovery

9: GSI DESCRIPTION

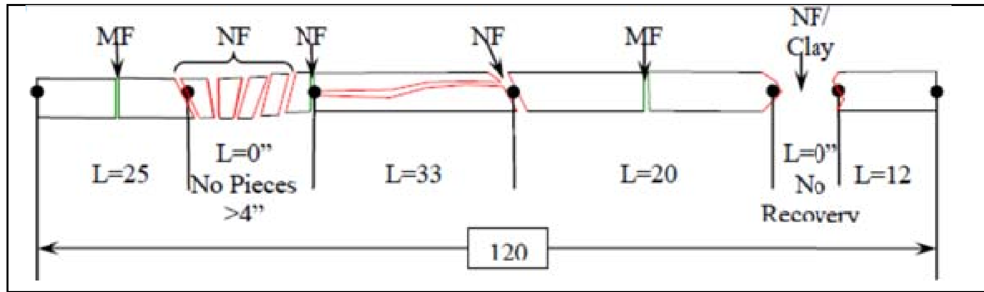
a: Structure

Description	Parameters
Intact or Massive	Intact rock with few widely spaced discontinuities
Blocky	Well interlocked undisturbed rock mass consisting of cubical blocks formed by three interesting discontinuity sets
Very Blocky	Interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
Blocky/Disturbed/ Seamy	Angular blocks formed by many intersecting discontinuity sets, Persistence of bedding planes
Disintegrated	Poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
Laminated/Sheared	Lack of blockiness due to close spacing of weak shear planes

b: Surface Condition

Description	Parameters
Very Good	Very rough, fresh unweathered surfaces
Good	Rough, slightly weathered, iron stained surface
Fair	Smooth, moderately weathered and altered surfaces
Poor	Slickensided, highly weathered surface with compact coatings or fillings or angular fragments
Very Poor	Slickensided, highly weathered surfaces with soft clay coating or fillings

10: RQD



$$RQD = \left(\frac{\sum Length\ \ of\ Pieces > 4inches}{Total\ Length\ of\ Core}\right) * 100$$

$$RQD = \left(\frac{25+33+20+12}{120}\right) * 100 = 75\%$$

Table 600.10. Strength of Bedrock

Description	Field Parameters	Range of Unconfined Compressive Strength	
		psi (ksf)	**MPa**
Extremely Strong	Cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.	Greater than 30,000 (> 4320)	Greater than 200
Very Strong	Cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.	15,000 to 30,000 (2160 to 4320)	100 to 200
Strong	Can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.	7500 to 15,000 (1080 to 2160)	50 to 100
Moderately Strong	Can be scratched with a knife or pick. Grooves or gouges to ¼” (6mm) deep can be excavated by hand blows of a geologist’s pick. Requires moderate hammer blows to detach hand specimen.	3600 to 7500 (520 to 1080)	25 to 50
Slightly Strong	Can be grooved or gouged 0.05 inch (2 mm) deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch (25 mm) maximum size by hard blows of the point of a geologist’s pick.	1500 to 3600 (215 to 520)	10 to 25
Weak	Can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.	750 to 1500 (108 to 215)	5 to 10
Very Weak	Can be carved with a knife. Can be excavated readily with a point of a pick. Pieces 1 inch (25 mm) or more in thickness can be broken by finger pressure. Can be scratched by fingernail.	40 to 750 (6 to 108)	0.3 to 5

SME

BORING B 1

PAGE 1 OF 1

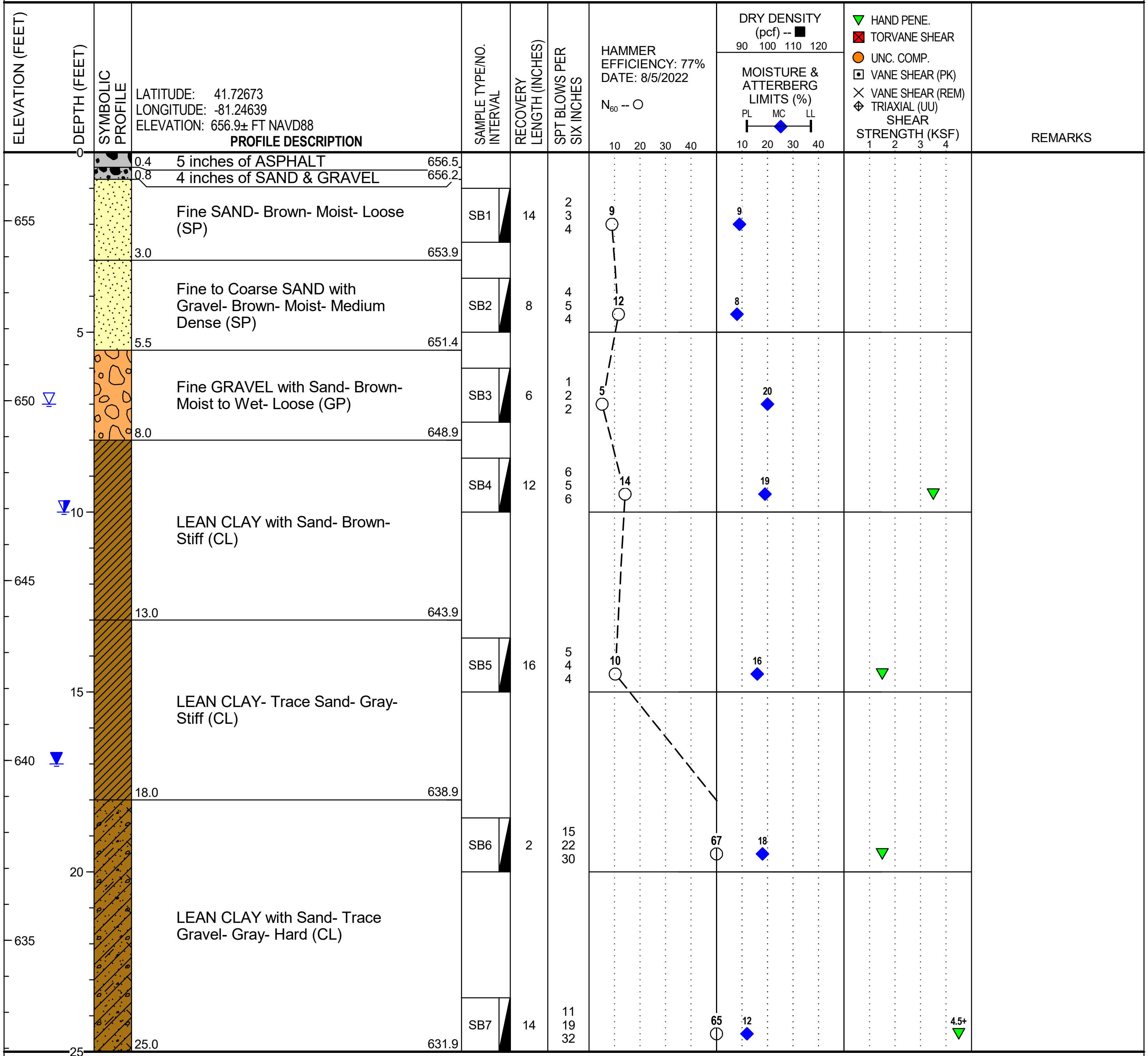
BORING DEPTH: 25 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: RM/ WI
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72673
LONGITUDE: -81.24639
ELEVATION: 656.9± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022



DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.4	5 inches of ASPHALT	656.5
0.8	4 inches of SAND & GRAVEL	656.2
3.0	Fine SAND- Brown- Moist- Loose (SP)	653.9
5.5	Fine to Coarse SAND with Gravel- Brown- Moist- Medium Dense (SP)	651.4
8.0	Fine GRAVEL with Sand- Brown- Moist to Wet- Loose (GP)	648.9
13.0	LEAN CLAY with Sand- Brown- Stiff (CL)	643.9
18.0	LEAN CLAY- Trace Sand- Gray- Stiff (CL)	638.9
25.0	LEAN CLAY with Sand- Trace Gravel- Gray- Hard (CL)	631.9

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MC (%)
SB1	14	2 3 4	9	9
SB2	8	4 5 4	12	8
SB3	6	1 2 2	5	20
SB4	12	6 5 6	14	19
SB5	16	5 4 4	10	16
SB6	2	15 22 30	67	18
SB7	14	11 19 32	65	12

END OF BORING AT 25.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
DURING BORING:	7.0	649.9
AT END OF BORING:	17.0	639.9
.25 HRS AFTER BORING:	10.0	646.9

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

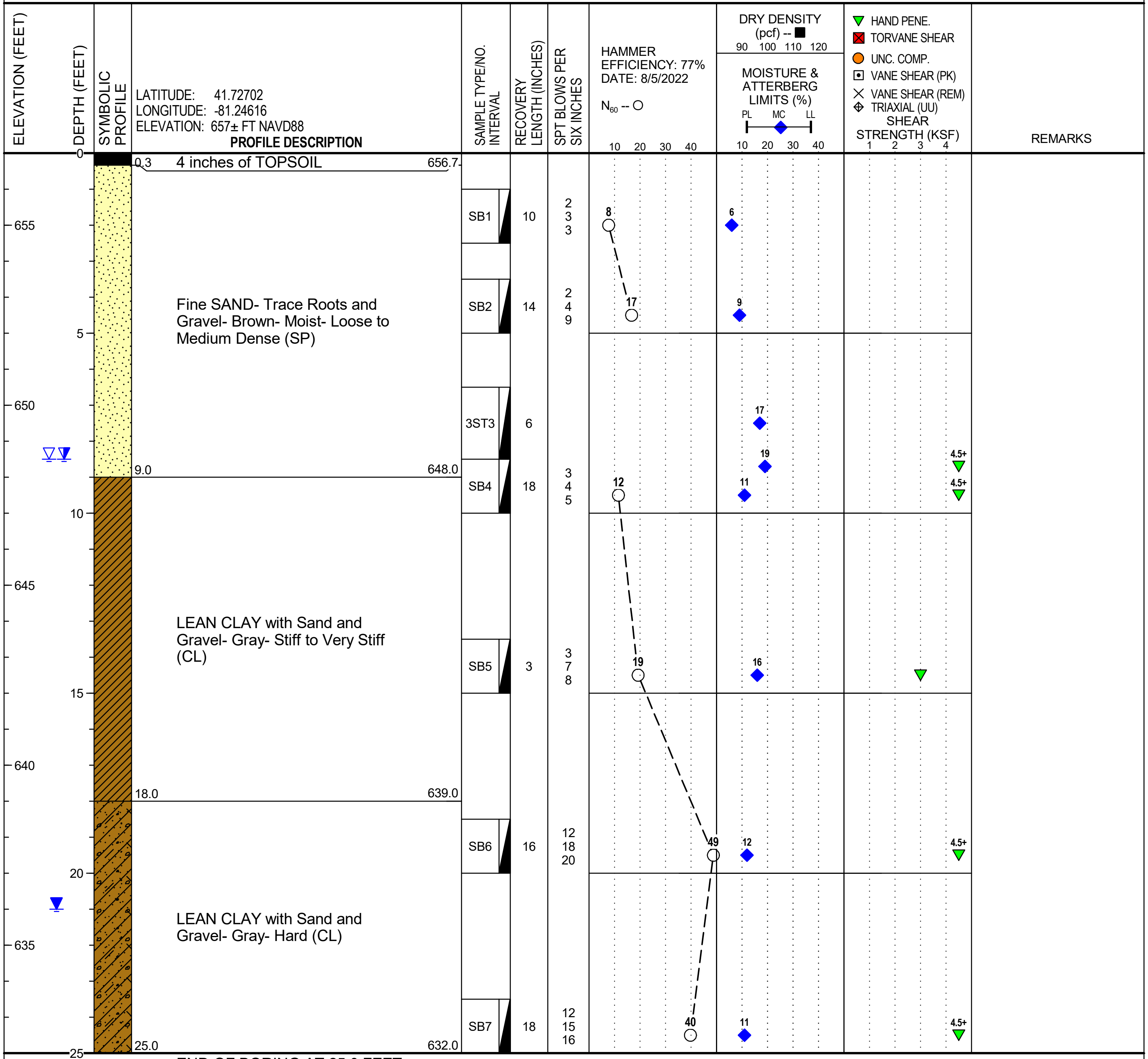
BORING B 2

PAGE 1 OF 1

BORING DEPTH: 25 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: JH/ RM
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO



END OF BORING AT 25.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	8.5	648.5
▼ **AT END OF BORING:**	21.0	636.0
▼ **.25 HRS AFTER BORING:**	8.5	648.5

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

SME

BORING B 3

PAGE 1 OF 2

BORING DEPTH: 43.6 FEET

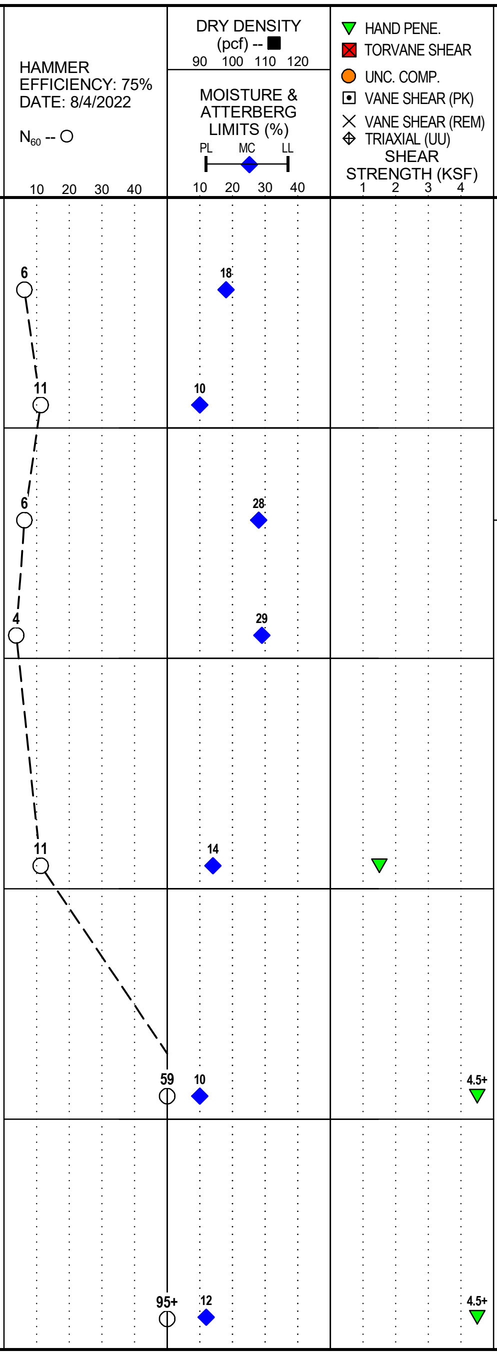
PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/28/23
COMPLETED: 8/28/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod & NQ Core
DRILLER: JH/ RM
RIG NO.: 290 (CME 45B)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72732
LONGITUDE: -81.24595
ELEVATION: 656.1± FT NAVD88

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.3	3 inches of TOPSOIL	655.9
3.0	FILL- Fine SAND with Gravel- Trace Roots- Brown and Black- Moist- Loose (SP)	653.1
6.0	Fine to Coarse SAND- Brown- Moist- Medium Dense (SP)	650.1
12.0	Fine to Medium SAND- Brown- Wet- Loose to Very Loose (SP)	644.1
17.0	LEAN CLAY with SAND- Gray- Stiff (CL)	639.1
	LEAN CLAY with Sand and Gravel- Gray- Hard (CL)	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
SB1	14	3 3 2	
SB2	18	3 4 5	
SB3	18	6 3 2	Sieve analysis performed on sample SB3.
SB4	6	1 2 1	
SB5	18	3 3 6	
SB6	18	19 21 26	
SB7	14	16 26 50/2"	



GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
∇ **DURING BORING:**	6.0	650.1
▼ **AT END OF BORING:**	19.0	637.1

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

(Continued Next Page)

BORING B 3

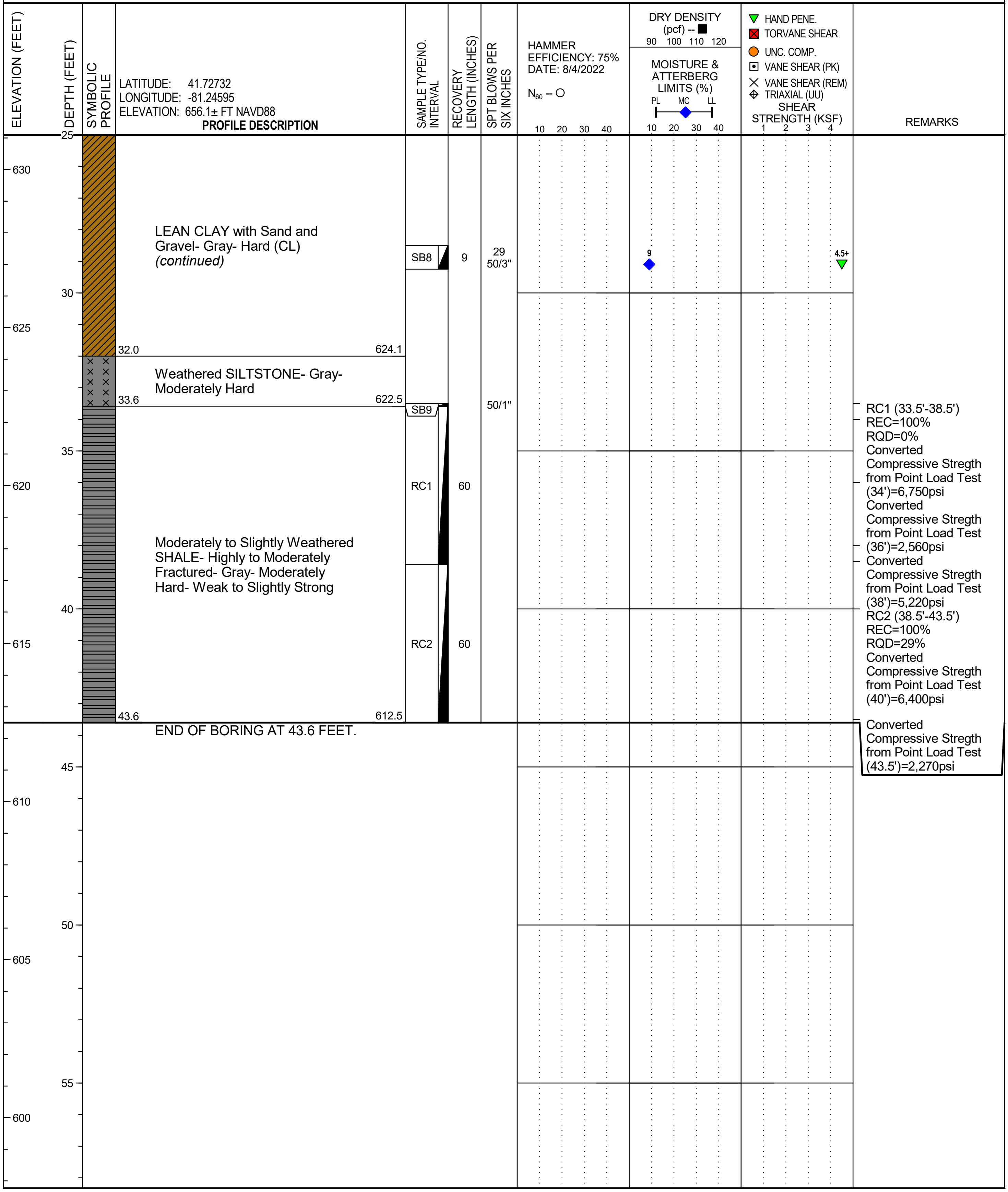
BORING DEPTH: 43.6 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72732
LONGITUDE: -81.24595
ELEVATION: 656.1± FT NAVD88

HAMMER EFFICIENCY: 75%
DATE: 8/4/2022



ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	MOISTURE & ATTERBERG LIMITS (%)	SHEAR STRENGTH (KSF)	REMARKS
624.1	32.0	LEAN CLAY with Sand and Gravel- Gray- Hard (CL) *(continued)*	SB8	9	29 50/3"	9	4.5+	
622.5	33.6	Weathered SILTSTONE- Gray- Moderately Hard	SB9		50/1"			
612.5	43.6	Moderately to Slightly Weathered SHALE- Highly to Moderately Fractured- Gray- Moderately Hard- Weak to Slightly Strong	RC1 RC2	60 60				RC1 (33.5'-38.5') REC=100% RQD=0% Converted Compressive Stregth from Point Load Test (34')=6,750psi Converted Compressive Stregth from Point Load Test (36')=2,560psi Converted Compressive Stregth from Point Load Test (38')=5,220psi RC2 (38.5'-43.5') REC=100% RQD=29% Converted Compressive Stregth from Point Load Test (40')=6,400psi Converted Compressive Stregth from Point Load Test (43.5')=2,270psi

END OF BORING AT 43.6 FEET.

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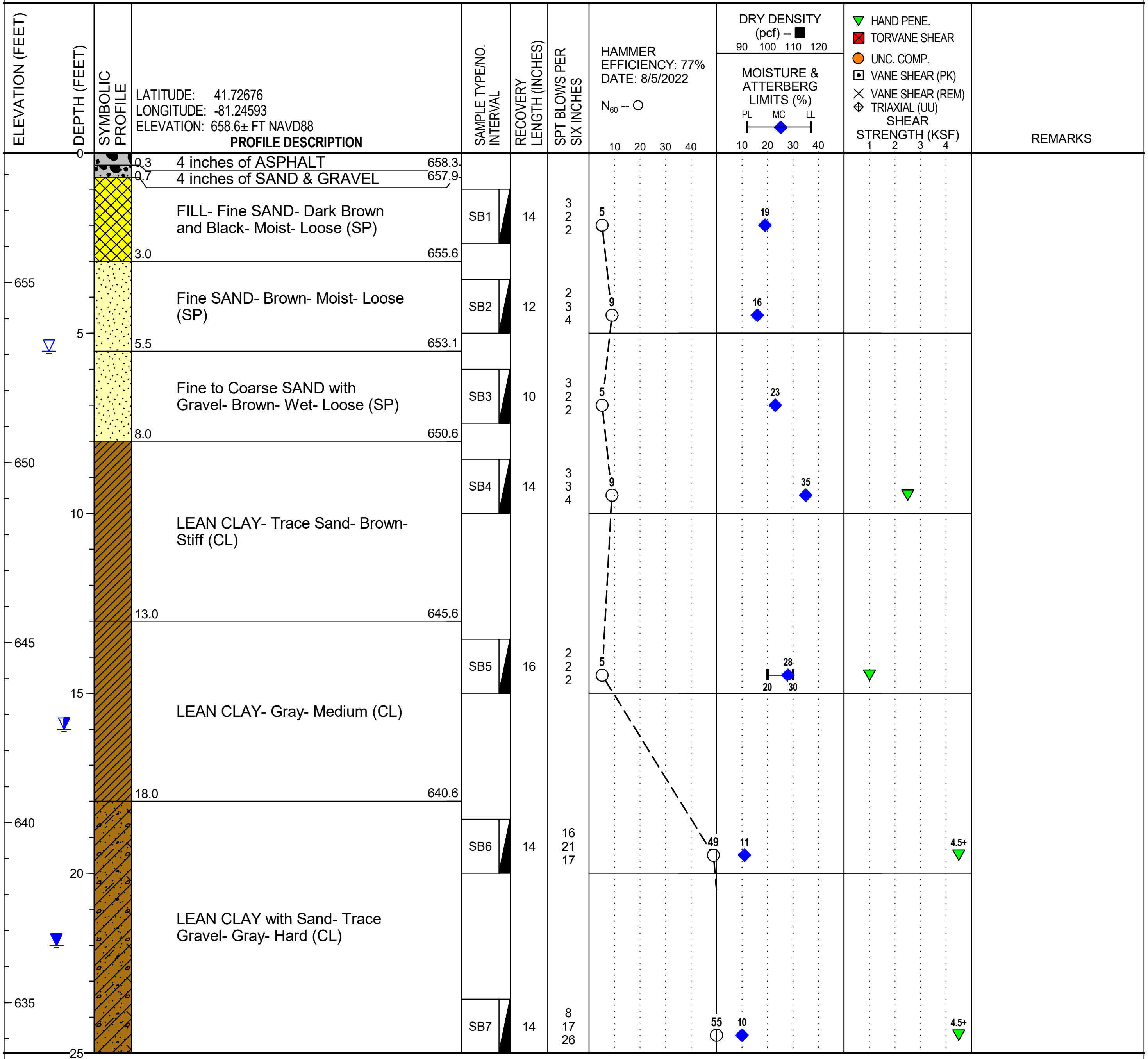
SME

BORING B 4

PAGE 1 OF 2

BORING DEPTH: 29.33 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: RM/ WI
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO



Depth (ft)	Elevation (ft)	Profile Description
0.3	658.3	4 inches of ASPHALT
0.7	657.9	4 inches of SAND & GRAVEL
3.0	655.6	FILL- Fine SAND- Dark Brown and Black- Moist- Loose (SP)
5.5	653.1	Fine SAND- Brown- Moist- Loose (SP)
8.0	650.6	Fine to Coarse SAND with Gravel- Brown- Wet- Loose (SP)
13.0	645.6	LEAN CLAY- Trace Sand- Brown- Stiff (CL)
18.0	640.6	LEAN CLAY- Gray- Medium (CL)
		LEAN CLAY with Sand- Trace Gravel- Gray- Hard (CL)

Sample	Recovery (in)	SPT Blows	N60	MC (%)	PL–LL	Hand Pene. (ksf)
SB1	14	3 2 2	5	19		
SB2	12	2 3 4	9	16		
SB3	10	3 2 2	5	23		
SB4	14	3 3 4	9	35		
SB5	16	2 2 2	5	28	20–30	
SB6	14	16 21 17	49	11		4.5+
SB7	14	8 17 26	55	10		4.5+

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	5.5	653.1
▼ **AT END OF BORING:**	22.0	636.6
▽ **.25 HRS AFTER BORING:**	16.0	642.6

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

(Continued Next Page)

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BORING B 4

PAGE 2 OF 2

BORING DEPTH: 29.33 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

LATITUDE: 41.72676
LONGITUDE: -81.24593
ELEVATION: 658.6± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022
N_{60} -- ○

DRY DENSITY (pcf) -- ■ (90 100 110 120)

MOISTURE & ATTERBERG LIMITS (%): PL MC LL (10 20 30 40)

SHEAR STRENGTH (KSF) (1 2 3 4):
- ▽ HAND PENE.
- ☒ TORVANE SHEAR
- ● UNC. COMP.
- ▣ VANE SHEAR (PK)
- × VANE SHEAR (REM)
- ◈ TRIAXIAL (UU)

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE & ATTERBERG LIMITS (%)	SHEAR STRENGTH (KSF)	REMARKS
629.3	25–29.3	LEAN CLAY with Sand- Trace Gravel- Gray- Hard (CL) *(continued)*	SB8	10	35 50/4"		13	4.5+	

END OF BORING AT 29.3 FEET.

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SME

BORING B 5

PAGE 1 OF 2

BORING DEPTH: 29.5 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

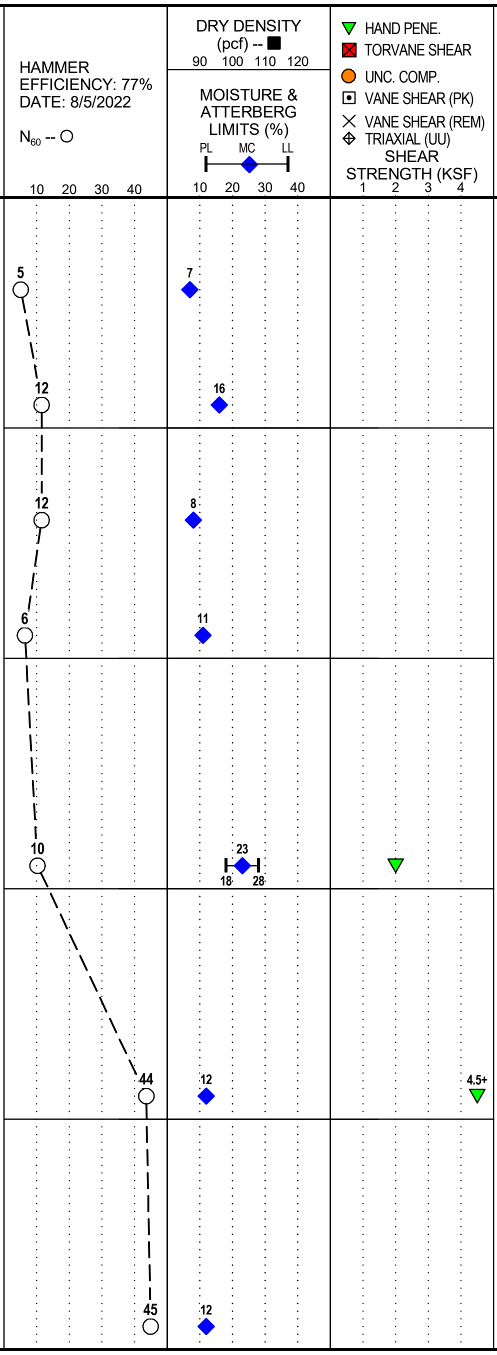
DATE STARTED: 8/29/23
COMPLETED: 8/29/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: JH/ RM/ WI
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72696
LONGITUDE: -81.24577
ELEVATION: 658.4± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.3	3 inches of TOPSOIL	658.2
7.0	Fine SAND- Brown- Moist- Loose to Medium Dense (SP)	651.4
13.0	Fine to Coarse SAND with Gravel- Brown- Moist- Medium Dense to Loose (SP)	645.4
18.0	LEAN CLAY- Gray- Stiff (CL)	640.4
	LEAN CLAY with Sand- Trace Shale Fragments- Gray- Hard (CL)	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N60 -- ○	MOISTURE (%)	PL	LL	HAND PENE. (KSF)
SB1	12	2 2 2	5	7			
SB2	12	3 4 5	12	16			
SB3	8	4 4 5	12	8			
SB4	4	4 3 2	6	11			
SB5	18	3 3 5	10	23	18	28	▼
SB6	18	9 14 20	44	12			4.5+
SB7	14	7 13 22	45	12			



REMARKS

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	7.0	651.4
▼ **AT END OF BORING:**	17.0	641.4
▼ **.25 HRS AFTER BORING:**	22.0	636.4

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

(Continued Next Page)

SME

BORING B 5

BORING DEPTH: 29.5 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72696
LONGITUDE: -81.24577
ELEVATION: 658.4± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022

ELEVATION (FEET)	DEPTH (FEET)	SYMBOLIC PROFILE	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60} -- ○ 10 20 30 40	DRY DENSITY (pcf) -- ■ 90 100 110 120 MOISTURE & ATTERBERG LIMITS (%) PL MC LL 10 20 30 40	▼ HAND PENE. ☒ TORVANE SHEAR ● UNC. COMP. ⊡ VANE SHEAR (PK) ✕ VANE SHEAR (REM) ⊕ TRIAXIAL (UU) SHEAR STRENGTH (KSF) 1 2 3 4	REMARKS
630	25	▨	LEAN CLAY with Sand- Trace Shale Fragments- Gray- Hard (CL) *(continued)*							
628.9	29.5	▨		SB8	12	29 50/6"		13		

END OF BORING AT 29.5 FEET.

SME

BORING B 6

PAGE 1 OF 2

BORING DEPTH: 38.58 FEET

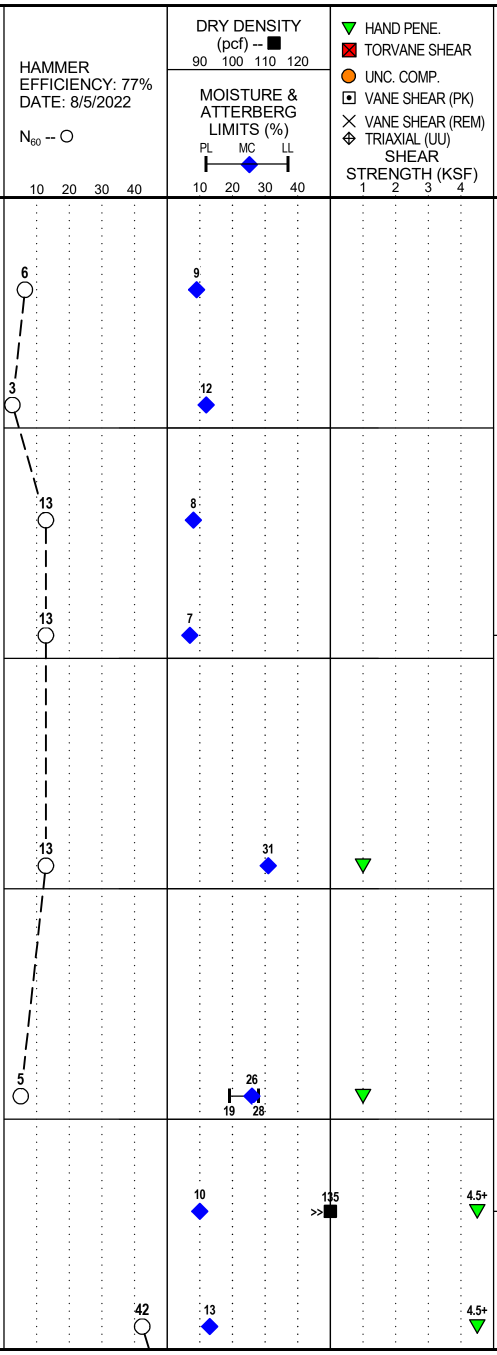
PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: RM/ WI
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72650
LONGITUDE: -81.24578
ELEVATION: 664.7± FT NAVD88

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.7	8 inches of ASPHALT	664.0
5.5	Fine SAND- Trace Roots- Brown- Moist- Loose to Very Loose (SP)	659.2
8.5	Fine to Coarse SAND- Trace Gravel- Brown- Moist- Medium Dense (SP)	656.2
13.0	Fine to Coarse CLAYEY to SILTY SAND with Gravel- Brown- Moist- Medium Dense (SC/SM)	651.7
14.5	LEAN CLAY- Brown- Stiff (CL)	650.2
21.5	LEAN CLAY- Gray- Medium (CL)	643.2
	LEAN CLAY with Sand and Gravel - Gray- Hard (CL)	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N60	MOISTURE (%)	REMARKS
SB1	10	2 3 2	6	9	
SB2	6	1 1 1	3	12	
SB3	12	2 4 6	13	8	
SB4	10	4 5 5	13	7	Sieve analysis performed on sample SB4.
SB5	12	7 6 4	13	31	
SB6	16	1 2 2	5	26 (PL 19, LL 28)	
3ST7	9			10	Sample ST7: Moist density = 147.7 pcf Dry density = 134.7 pcf
SB8	14	10 14 19	42	13	



GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	13.0	651.7
▼ **AT END OF BORING:**	29.0	635.7
▽ **.25 HRS AFTER BORING:**	17.0	647.7

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

(Continued Next Page)

SME

BORING B 6

PAGE 2 OF 2

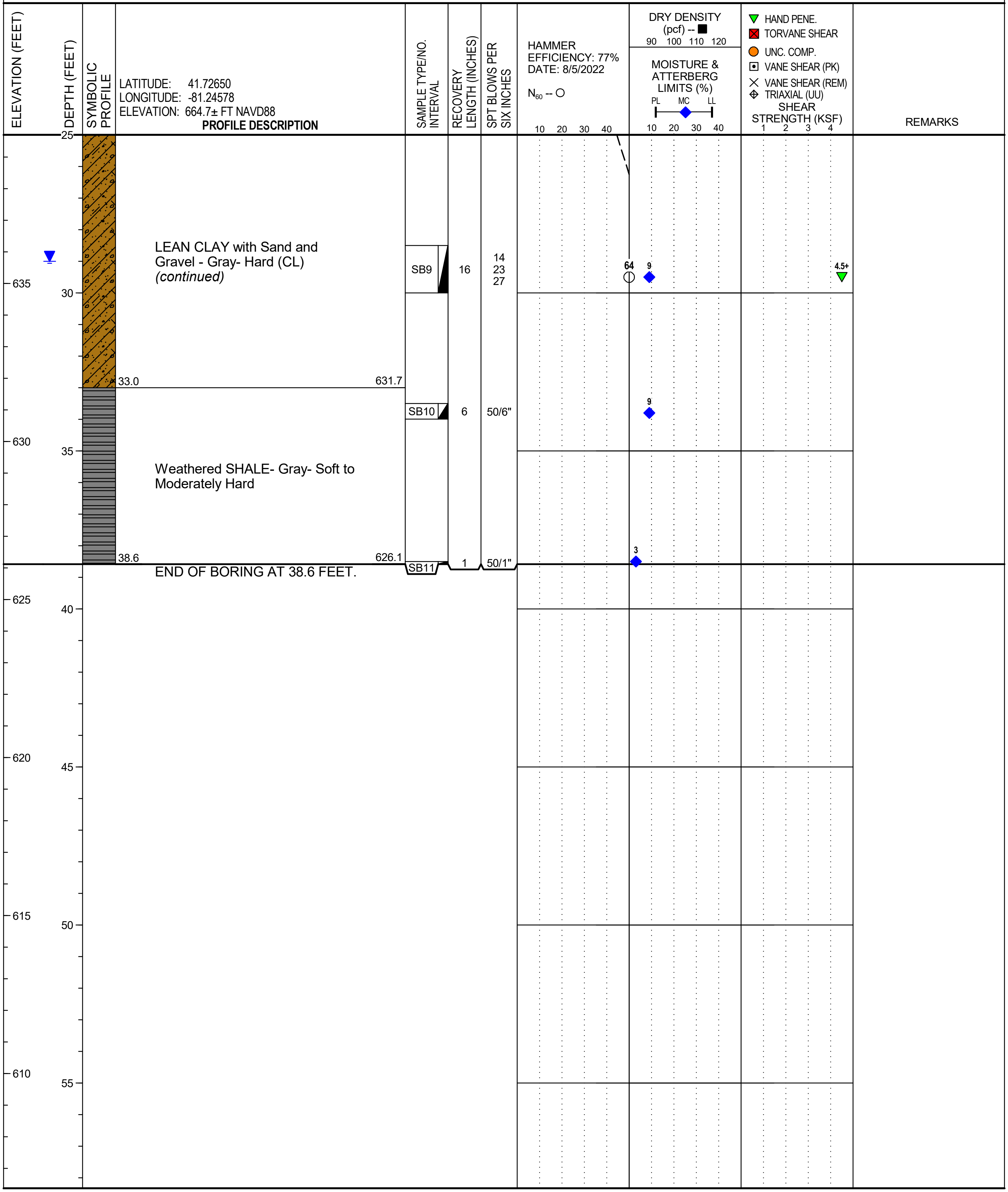
BORING DEPTH: 38.58 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

LATITUDE: 41.72650
LONGITUDE: -81.24578
ELEVATION: 664.7± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%) MC	SHEAR STRENGTH (KSF) HAND PENE.	REMARKS
	25	LEAN CLAY with Sand and Gravel - Gray- Hard (CL) *(continued)*							
			SB9	16	14 23 27	64	9	4.5+	
631.7	33.0	Weathered SHALE- Gray- Soft to Moderately Hard							
			SB10	6	50/6"		9		
626.1	38.6	END OF BORING AT 38.6 FEET.	SB11	1	50/1"		3		



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SME

BORING B 7

PAGE 1 OF 2

BORING DEPTH: 49 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/29/23
COMPLETED: 8/29/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod & NQ Core
DRILLER: JH/ RM/ WI
RIG NO.: 293 (CME 55)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72680
LONGITUDE: -81.24553
ELEVATION: 663.7± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022

N$_{60}$ -- ○

DRY DENSITY (pcf) -- ■ 90 100 110 120

MOISTURE & ATTERBERG LIMITS (%) PL MC LL 10 20 30 40

▼ HAND PENE.
☒ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)
SHEAR STRENGTH (KSF) 1 2 3 4

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.3	3 inches of ASPHALT	663.5
0.6	4 inches of SAND & GRAVEL	663.1
13.0	Fine SAND- Brown- Moist- Loose to Medium Dense (SP)	650.7
19.0	Fine to Coarse SAND with Gravel- Brown- Moist to Wet- Loose (SP)	644.7
22.0	LEAN CLAY- Gray- Stiff (CL)	641.7
	LEAN CLAY with Sand and Gravel- Gray- Very Stiff to Hard (CL)	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N$_{60}$	MC (%)	HAND PENE. (KSF)
SB1	12	3 3 3	8	8	
SB2	12	3 3 3	8	8	
SB3	14	3 4 5	12	12	
SB4	10	5 6 5	14	11	
SB5	6	3 2 3	6	12	
SB6	12	3 5 7	15	18	▼
SB7	14	9 11 12	30	11	4.5+

REMARKS

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	14.5	649.2
▼ AT END OF BORING:	21.0	642.7

BACKFILL METHOD: Auger Cuttings & Bentonite Chips

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

(Continued Next Page)

BORING B 7

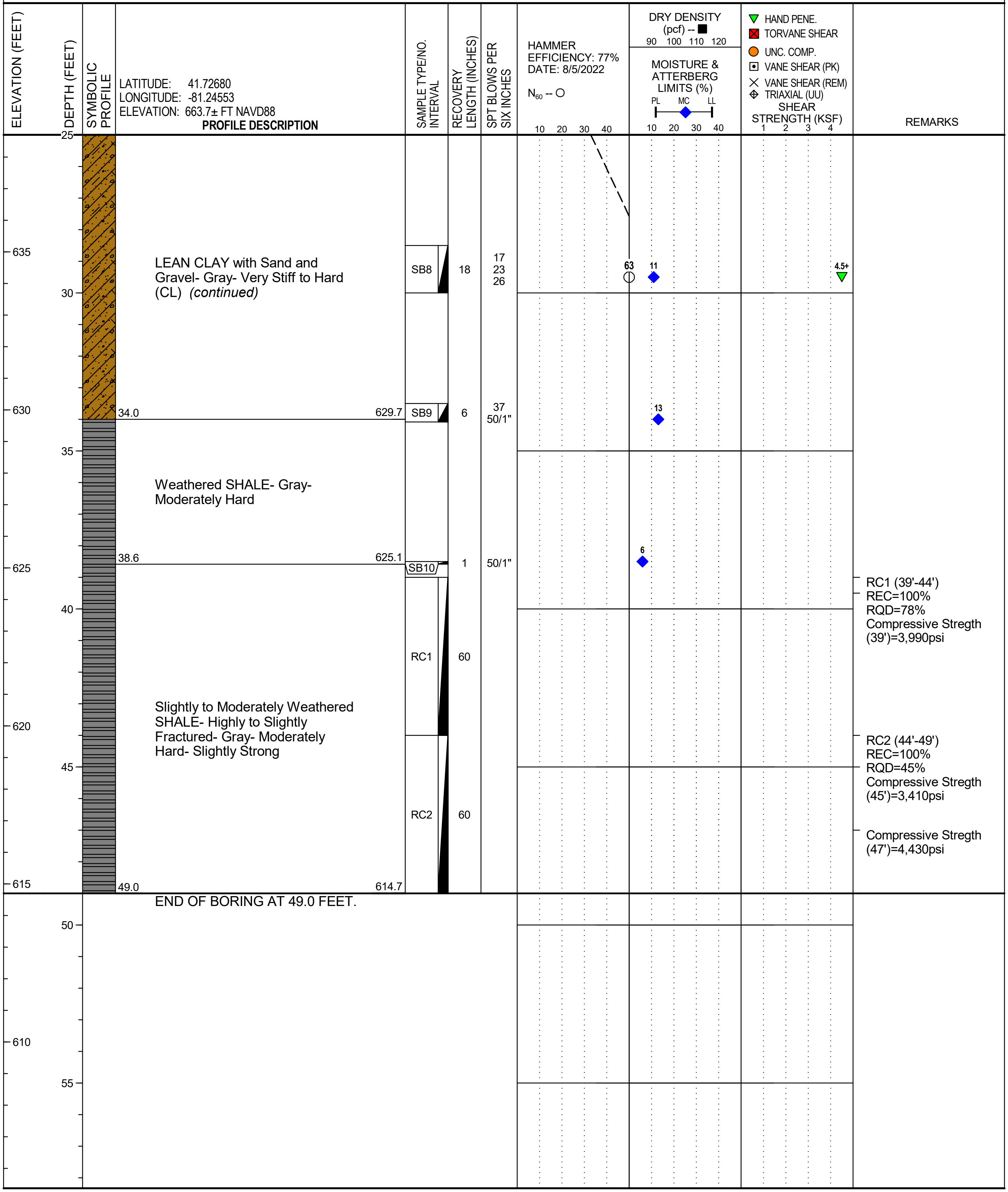
BORING DEPTH: 49 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72680
LONGITUDE: -81.24553
ELEVATION: 663.7± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022



Depth (ft)	Elevation	Profile Description	Sample	Recovery (in)	SPT Blows per Six Inches	N_{60}	MC (%)	Shear Strength (KSF)	Remarks
25.0–34.0	629.7	LEAN CLAY with Sand and Gravel- Gray- Very Stiff to Hard (CL) *(continued)*	SB8	18	17 23 26	63	11	4.5+	
			SB9	6	37 50/1"		13		
34.0–38.6	625.1	Weathered SHALE- Gray- Moderately Hard	SB10	1	50/1"		6		
38.6–49.0	614.7	Slightly to Moderately Weathered SHALE- Highly to Slightly Fractured- Gray- Moderately Hard- Slightly Strong	RC1	60					RC1 (39'-44') REC=100% RQD=78% Compressive Stregth (39')=3,990psi
			RC2	60					RC2 (44'-49') REC=100% RQD=45% Compressive Stregth (45')=3,410psi Compressive Stregth (47')=4,430psi

END OF BORING AT 49.0 FEET.

SME

BORING B 8

PAGE 1 OF 2

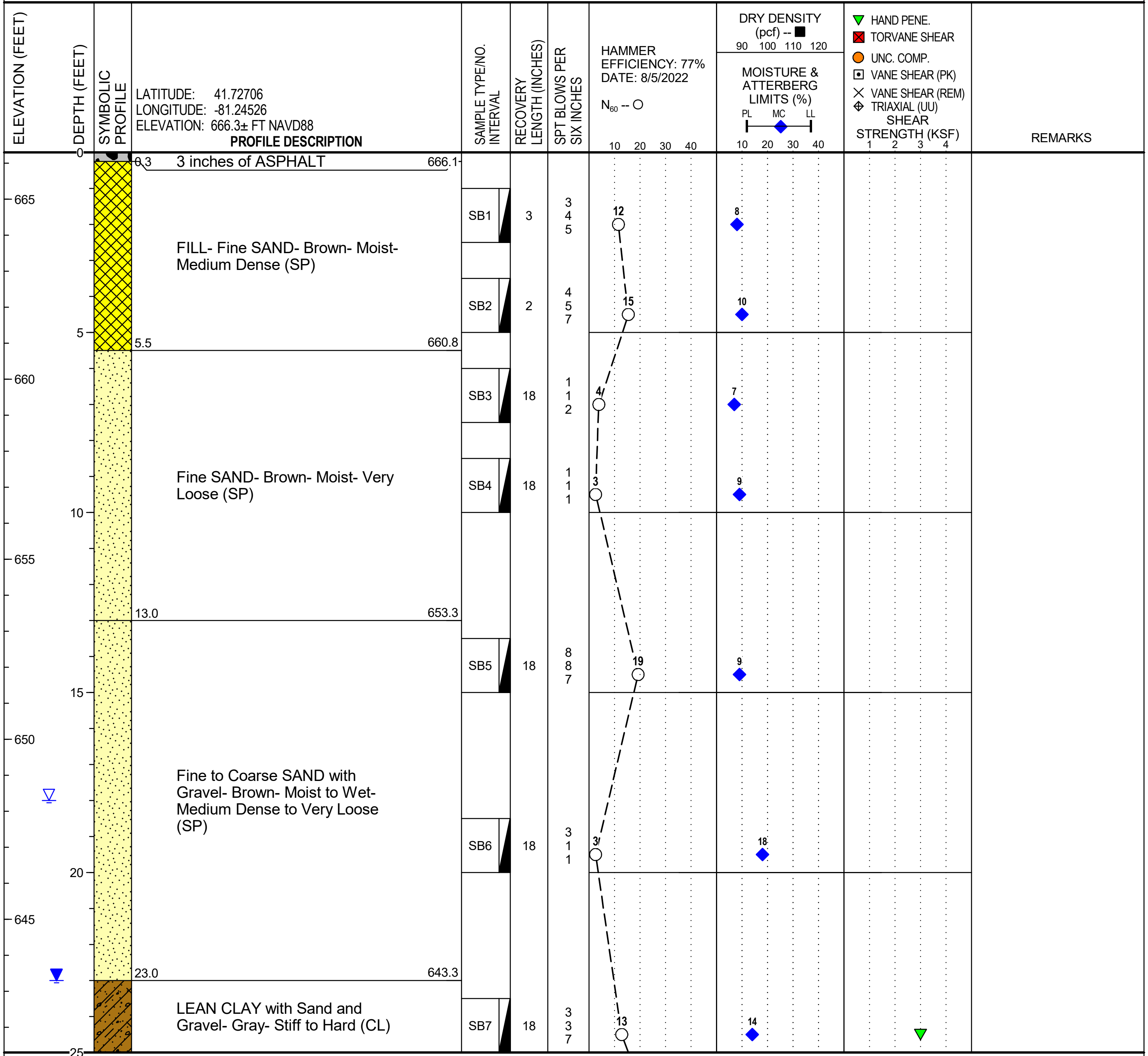
BORING DEPTH: 39 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

DATE STARTED: 8/25/23 **COMPLETED:** 8/25/23 **BORING METHOD:** 3 3/4" Hollow-stem Augers W/ AW Rod

DRILLER: JH/ RM **RIG NO.:** 293 (CME 55) **LOGGED BY:** BAM **CHECKED BY:** TPO



LATITUDE: 41.72706
LONGITUDE: -81.24526
ELEVATION: 666.3± FT NAVD88

Depth (ft)	PROFILE DESCRIPTION	Elevation (ft)
0.3	3 inches of ASPHALT	666.1
5.5	FILL- Fine SAND- Brown- Moist- Medium Dense (SP)	660.8
13.0	Fine SAND- Brown- Moist- Very Loose (SP)	653.3
23.0	Fine to Coarse SAND with Gravel- Brown- Moist to Wet- Medium Dense to Very Loose (SP)	643.3
	LEAN CLAY with Sand and Gravel- Gray- Stiff to Hard (CL)	

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MC (%)
SB1	3	3 4 5	12	8
SB2	2	4 5 7	15	10
SB3	18	1 1 2	4	7
SB4	18	1 1 1	3	9
SB5	18	8 8 7	19	9
SB6	18	3 1 1	3	18
SB7	18	3 3 7	13	14

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	18.0	648.3
▼ **AT END OF BORING:**	23.0	643.3

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

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SME

BORING B 8

PAGE 2 OF 2

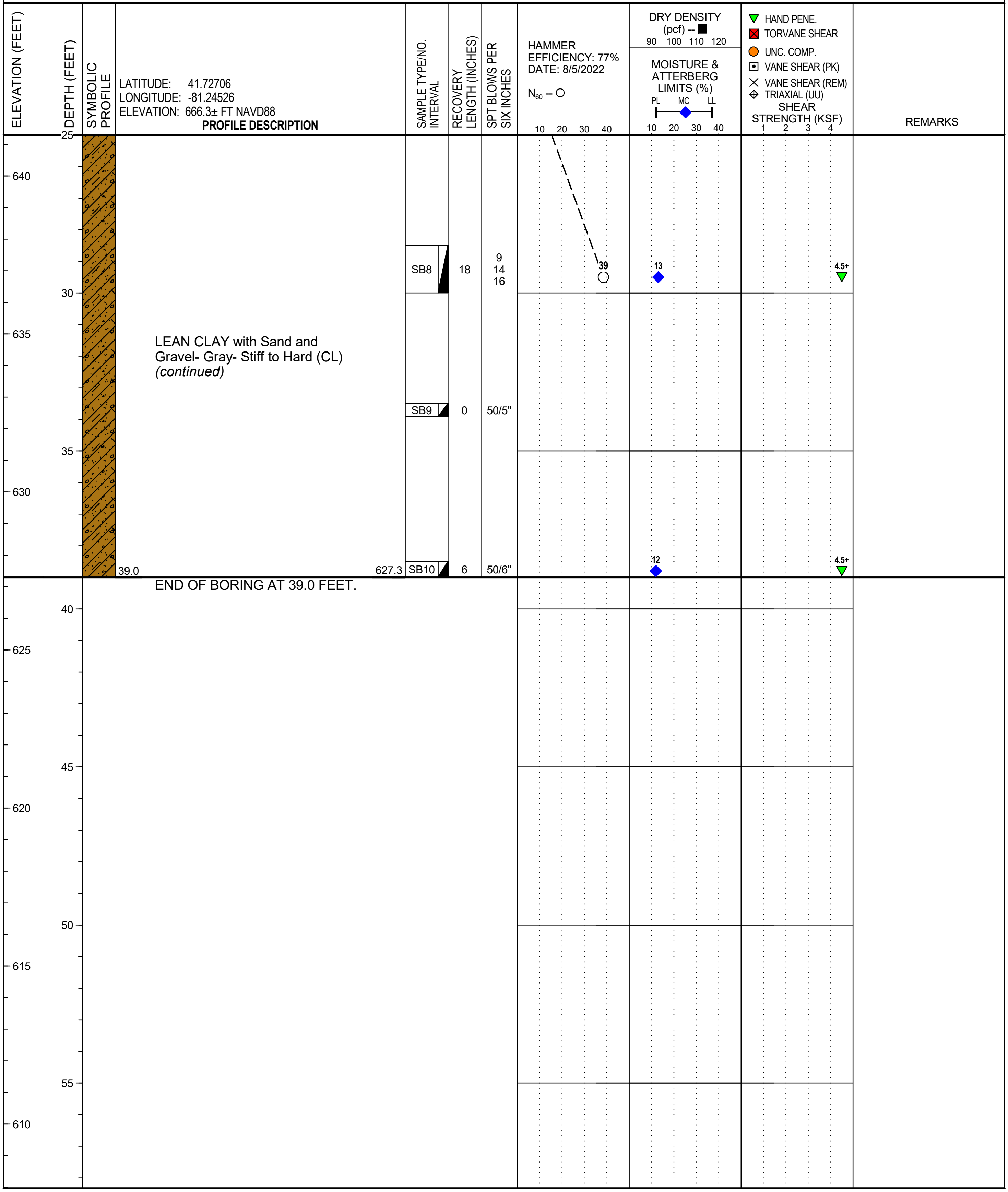
BORING DEPTH: 39 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72706
LONGITUDE: -81.24526
ELEVATION: 666.3± FT NAVD88

HAMMER EFFICIENCY: 77%
DATE: 8/5/2022



LEAN CLAY with Sand and Gravel- Gray- Stiff to Hard (CL) *(continued)*

39.0 627.3

END OF BORING AT 39.0 FEET.

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
SB8	18	9 14 16
SB9	0	50/5"
SB10	6	50/6"

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BORING B 9

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

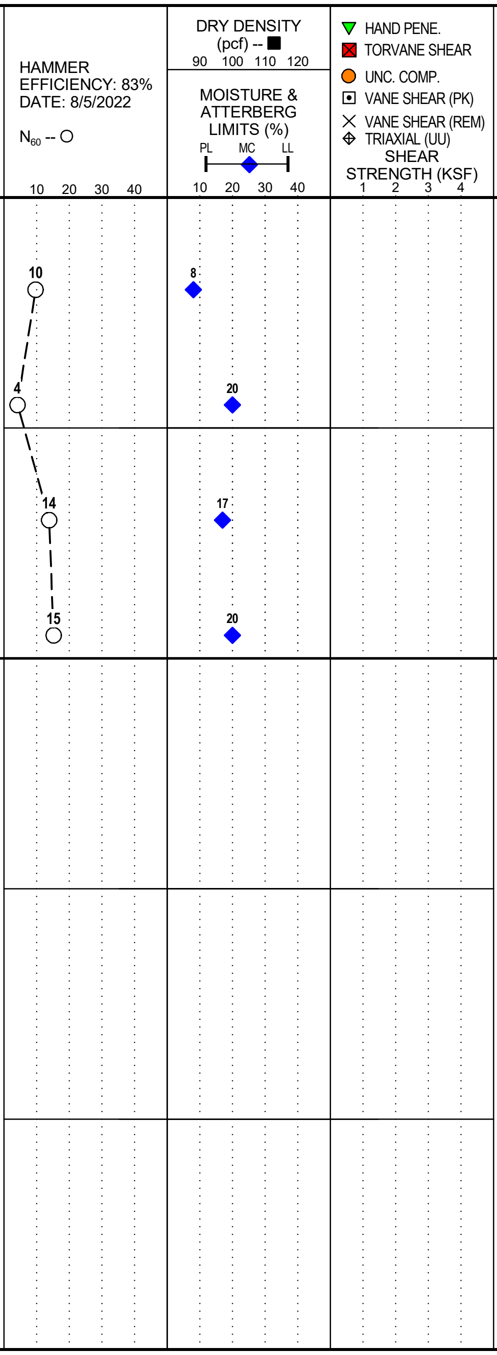
DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 4" Solid-stem Augers w/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72698
LONGITUDE: -81.24681
ELEVATION: 655.8± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
0.5	6 inches of ASPHALT	655.3				
0.7	2 inches of SAND & GRAVEL	655.1				
3.0	Fine SAND- Brown- Moist- Loose (SP)	652.8	SB1	18	4 4 3	
8.0	Fine to Coarse SAND with Clay and Gravel- Brown- Moist- Very Loose to Medium Dense (SP)	647.8	SB2 SB3	18 4	2 1 2 4 5 5	
10.0	LEAN CLAY- Gray- Varved- Stiff (CL)	645.8	SB4	18	2 5 6	

END OF BORING AT 10.0 FEET.



GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	7.5	648.3
▼ **AT END OF BORING:**	8.0	647.8
▼ **.25 HRS AFTER BORING:**	9.5	646.3

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

SME

BORING B10

PAGE 1 OF 1

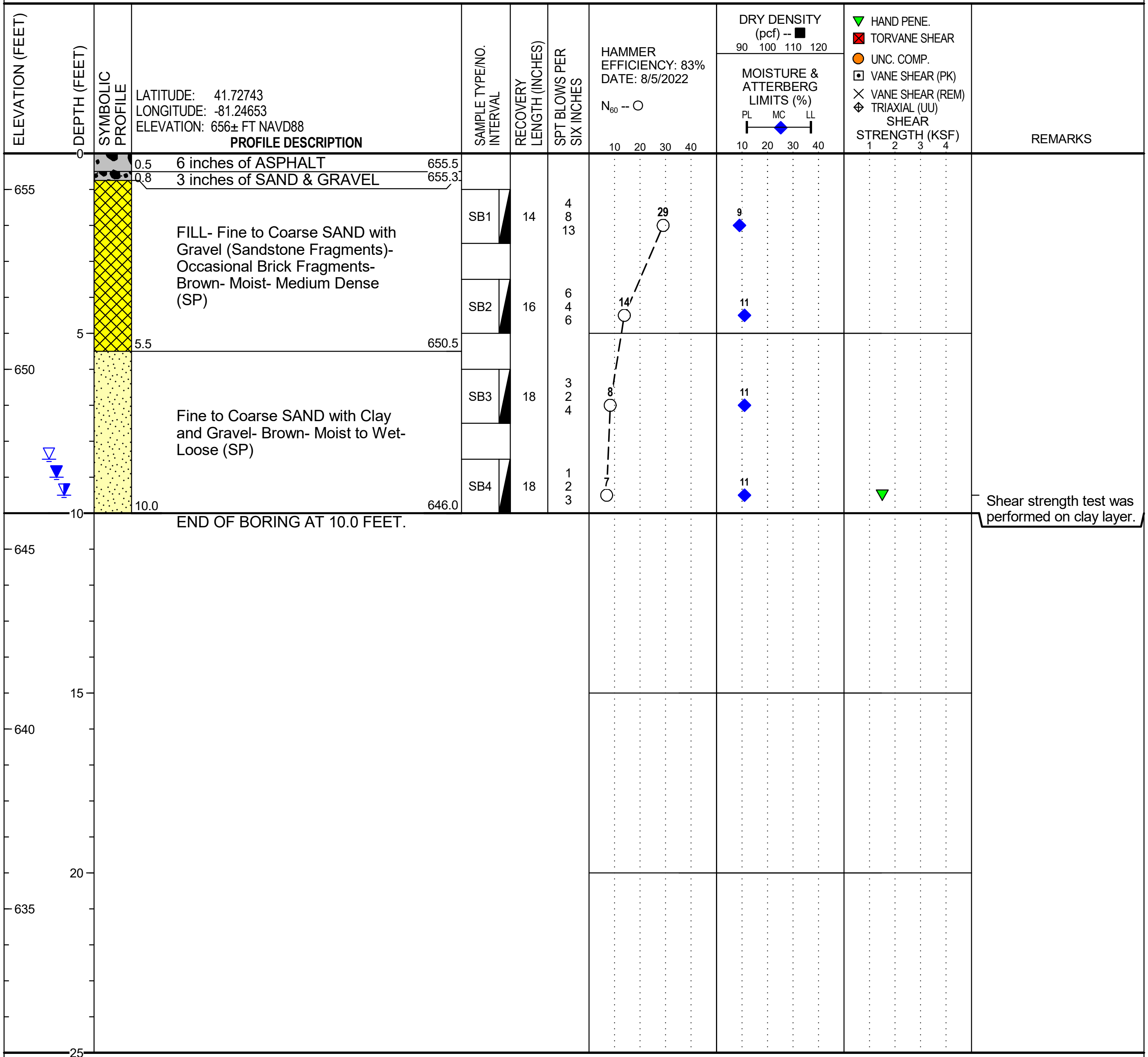
BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

DATE STARTED: 8/25/23 **COMPLETED:** 8/25/23 **BORING METHOD:** 4" Solid-stem Augers w/ AW Rod

DRILLER: EP/ SS **RIG NO.:** 635 (CME 55 ATV) **LOGGED BY:** BAM **CHECKED BY:** TPO



LATITUDE: 41.72743
LONGITUDE: -81.24653
ELEVATION: 656± FT NAVD88

PROFILE DESCRIPTION

Depth (ft)	Profile Description	Elevation
0.5	6 inches of ASPHALT	655.5
0.8	3 inches of SAND & GRAVEL	655.3
5.5	FILL- Fine to Coarse SAND with Gravel (Sandstone Fragments)- Occasional Brick Fragments- Brown- Moist- Medium Dense (SP)	650.5
10.0	Fine to Coarse SAND with Clay and Gravel- Brown- Moist to Wet- Loose (SP)	646.0

END OF BORING AT 10.0 FEET.

Sample Type/No.	Recovery Length (Inches)	SPT Blows per Six Inches	N_{60}	Moisture (%)
SB1	14	4 8 13	29	9
SB2	16	6 4 6	14	11
SB3	18	3 2 4	8	11
SB4	18	1 2 3	7	11

Shear strength test was performed on clay layer.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	8.5	647.5
▼ **AT END OF BORING:**	9.0	647.0
▼ **.25 HRS AFTER BORING:**	9.5	646.5

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

SME

BORING B11

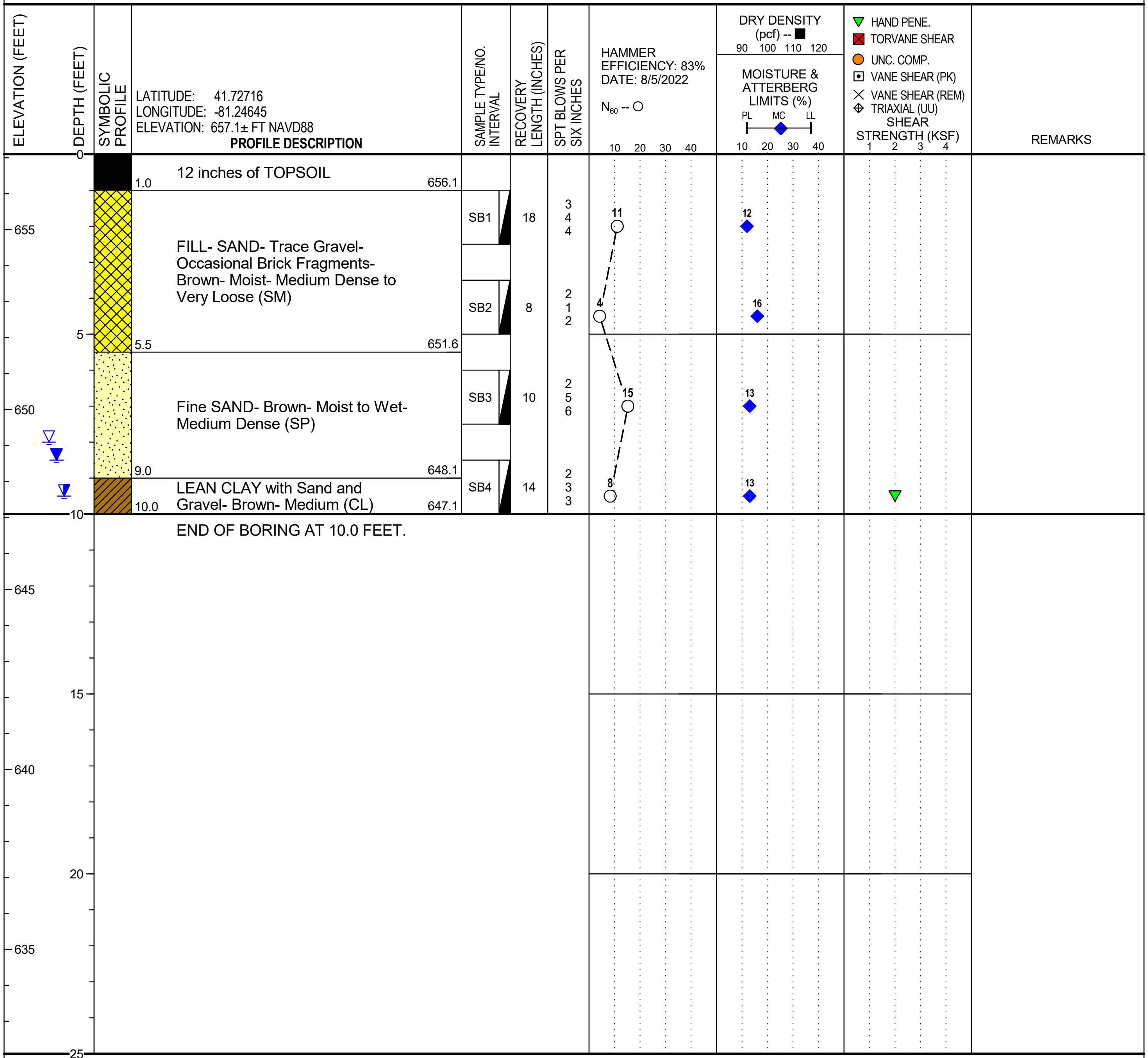
PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 4" Solid-stem Augers w/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72716
LONGITUDE: -81.24645
ELEVATION: 657.1± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022



Depth (ft)	Elev. (ft)	Profile Description	Sample	Recovery (in)	SPT Blows	N60	Moisture (%)
1.0	656.1	12 inches of TOPSOIL					
5.5	651.6	FILL- SAND- Trace Gravel- Occasional Brick Fragments- Brown- Moist- Medium Dense to Very Loose (SM)	SB1	18	3 4 4	11	12
			SB2	8	2 1 2	4	16
9.0	648.1	Fine SAND- Brown- Moist to Wet- Medium Dense (SP)	SB3	10	2 5 6	15	13
10.0	647.1	LEAN CLAY with Sand and Gravel- Brown- Medium (CL)	SB4	14	2 3 3	8	13

END OF BORING AT 10.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	8.0	649.1
▼ **AT END OF BORING:**	8.5	648.6
▼ **.25 HRS AFTER BORING:**	9.5	647.6

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

BORING B12

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

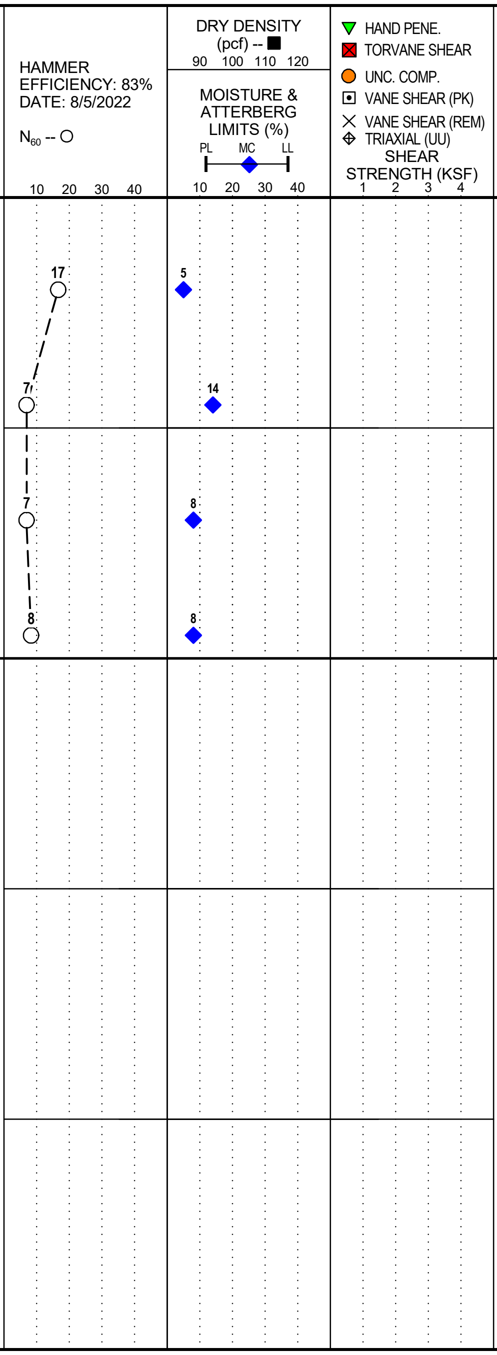
DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 4" Solid-stem Augers w/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72851
LONGITUDE: -81.24558
ELEVATION: 657.5± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)	REMARKS
0.3	3 inches of ASPHALT	657.3						
0.5	3 inches of SAND & GRAVEL	657.0						
3.0	FILL- Fine to Coarse Sand with Gravel (Limestone Fragments)- Brown and Gray- Moist- Medium Dense (SP)	654.5	SB1	12	5 6 6	17	5	
			SB2	18	3 3 2	7	14	
			SB3	12	1 2 3	7	8	
10.0	Fine SAND- Trace Gravel- Brown- Moist- Loose (SP)	647.5	SB4	16	2 2 4	8	8	

END OF BORING AT 10.0 FEET.



GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

10/20/23 2:14:44 PM

BORING B13

PAGE 1 OF 1

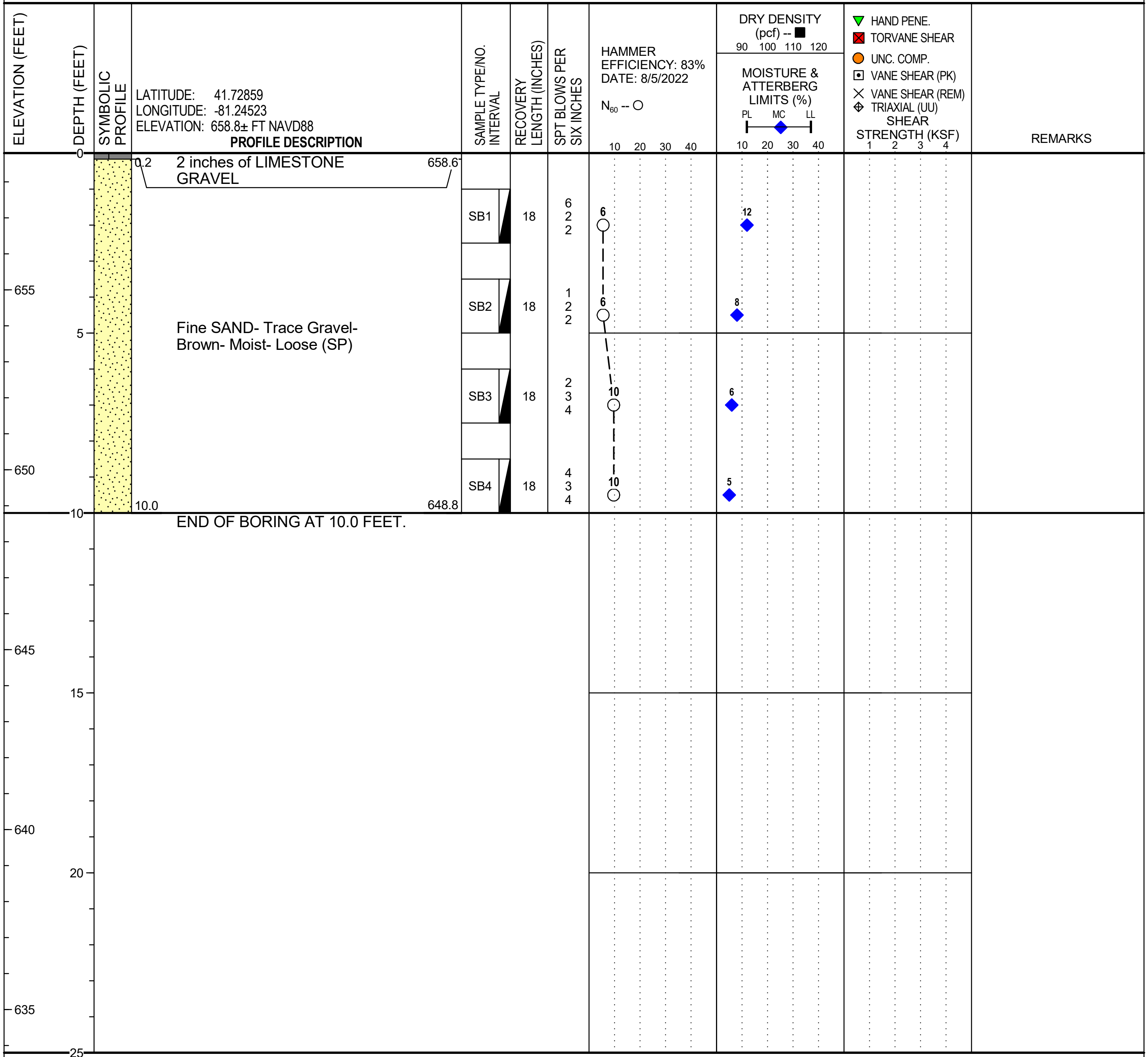
BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

DATE STARTED: 8/25/23 **COMPLETED:** 8/25/23 **BORING METHOD:** 3 3/4" Hollow-stem Augers W/ AW Rod

DRILLER: EP/ SS **RIG NO.:** 635 (CME 55RT) **LOGGED BY:** BAM **CHECKED BY:** TPO



LATITUDE: 41.72859
LONGITUDE: -81.24523
ELEVATION: 658.8± FT NAVD88

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
0.2	2 inches of LIMESTONE GRAVEL	658.6				
	Fine SAND- Trace Gravel- Brown- Moist- Loose (SP)		SB1	18	6 2 2	
			SB2	18	1 2 2	
			SB3	18	2 3 4	
10.0		648.8	SB4	18	4 3 4	
	END OF BORING AT 10.0 FEET.					

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

SME

BORING B14

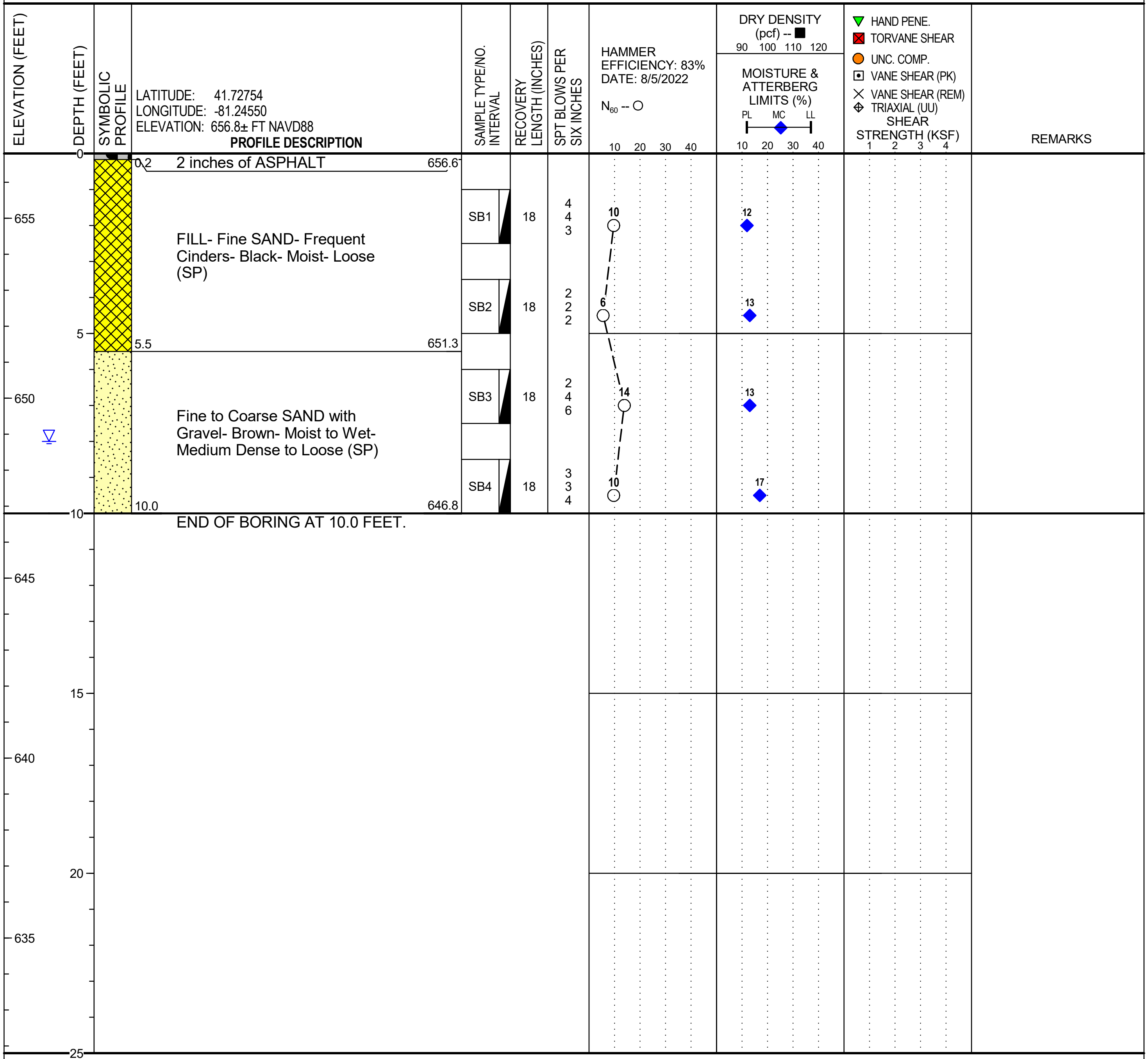
PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 4" Hollow-stem Augers W/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72754
LONGITUDE: -81.24550
ELEVATION: 656.8± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022



DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
0.2	656.6	2 inches of ASPHALT
5.5	651.3	FILL- Fine SAND- Frequent Cinders- Black- Moist- Loose (SP)
10.0	646.8	Fine to Coarse SAND with Gravel- Brown- Moist to Wet- Medium Dense to Loose (SP)

END OF BORING AT 10.0 FEET.

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)
SB1	18	4 4 3	10	12
SB2	18	2 2 2	6	13
SB3	18	2 4 6	14	13
SB4	18	3 3 4	10	17

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	8.0	648.8
▼ **AT END OF BORING:**	Note 3	

BACKFILL METHOD: Auger Cuttings

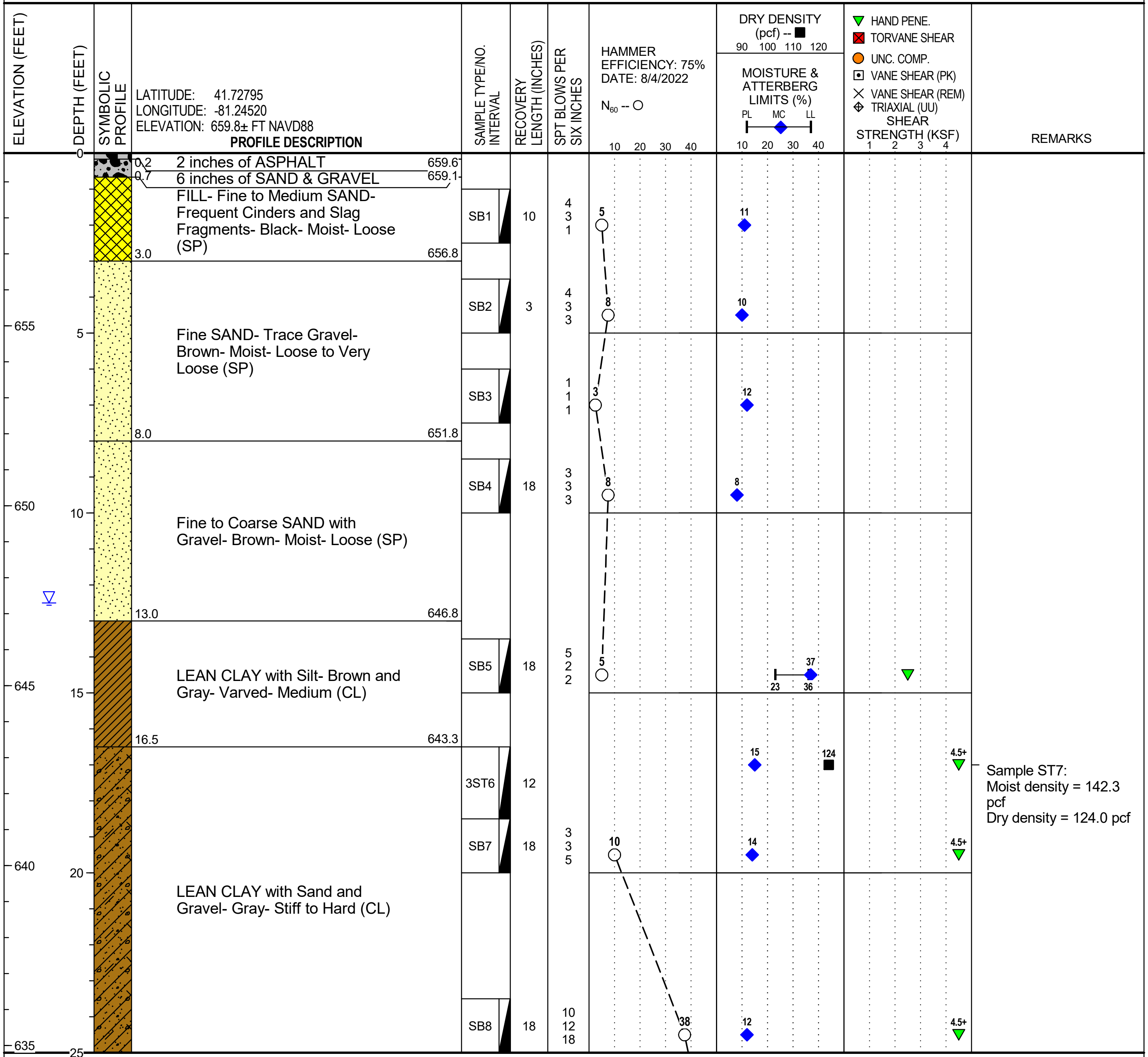
NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Groundwater was not encountered upon completion of drilling.
4. Surface capped with EPCO hole plug after backfilling the borehole.

BORING B15

PAGE 1 OF 2

BORING DEPTH: 38.5 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 3 3/4" Hollow-stem Augers W/ AW Rod
DRILLER: JH/ RM
RIG NO.: 290 (CME 45B)
LOGGED BY: BAM
CHECKED BY: TPO



Depth (ft)	Profile Description	Elevation
0.2	2 inches of ASPHALT	659.6
0.7	6 inches of SAND & GRAVEL	659.1
3.0	FILL- Fine to Medium SAND- Frequent Cinders and Slag Fragments- Black- Moist- Loose (SP)	656.8
8.0	Fine SAND- Trace Gravel- Brown- Moist- Loose to Very Loose (SP)	651.8
13.0	Fine to Coarse SAND with Gravel- Brown- Moist- Loose (SP)	646.8
16.5	LEAN CLAY with Silt- Brown and Gray- Varved- Medium (CL)	643.3
	LEAN CLAY with Sand and Gravel- Gray- Stiff to Hard (CL)	

Sample	Recovery	SPT Blows	N_{60}	PL	MC	LL	Dry Density	Shear Strength	Remarks
SB1	10	4 3 1	5		11				
SB2	3	4 3 3	8		10				
SB3		1 1 1	3		12				
SB4	18	3 3 3	8		8				
SB5	18	5 2 2	5	23	37	36		▼	
3ST6	12				15		124	4.5+	Sample ST7: Moist density = 142.3 pcf Dry density = 124.0 pcf
SB7	18	3 3 5	10		14			4.5+	
SB8	18	10 12 18	38		12			4.5+	

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	12.5	647.3
▼ **AT END OF BORING:**	29.0	630.8
.25 HRS AFTER BORING:	Note 3	
CAVE-IN OF BOREHOLE AT:	16.0	643.8

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Groundwater was not encountered above borehole cave-in depth during delayed groundwater level reading.
4. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

(Continued Next Page)

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BORING B15

PAGE 2 OF 2

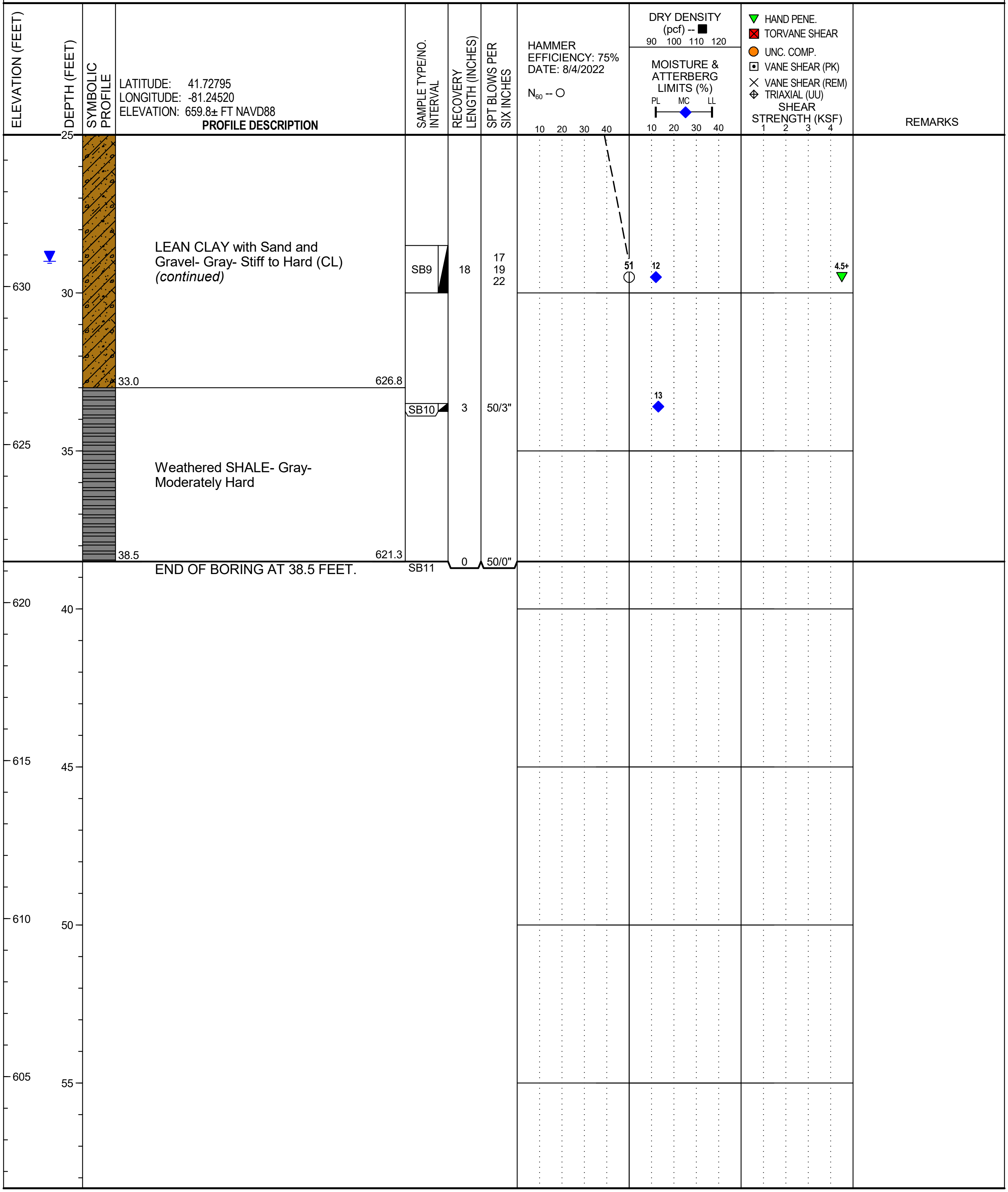
BORING DEPTH: 38.5 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72795
LONGITUDE: -81.24520
ELEVATION: 659.8± FT NAVD88

HAMMER EFFICIENCY: 75%
DATE: 8/4/2022



DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MC (%)	SHEAR STRENGTH (KSF)	REMARKS
		LEAN CLAY with Sand and Gravel- Gray- Stiff to Hard (CL) *(continued)*	SB9	18	17 19 22	51	12	4.5+	
33.0	626.8	Weathered SHALE- Gray- Moderately Hard	SB10	3	50/3"		13		
38.5	621.3		SB11	0	50/0"				
		END OF BORING AT 38.5 FEET.							

SME

BORING B16

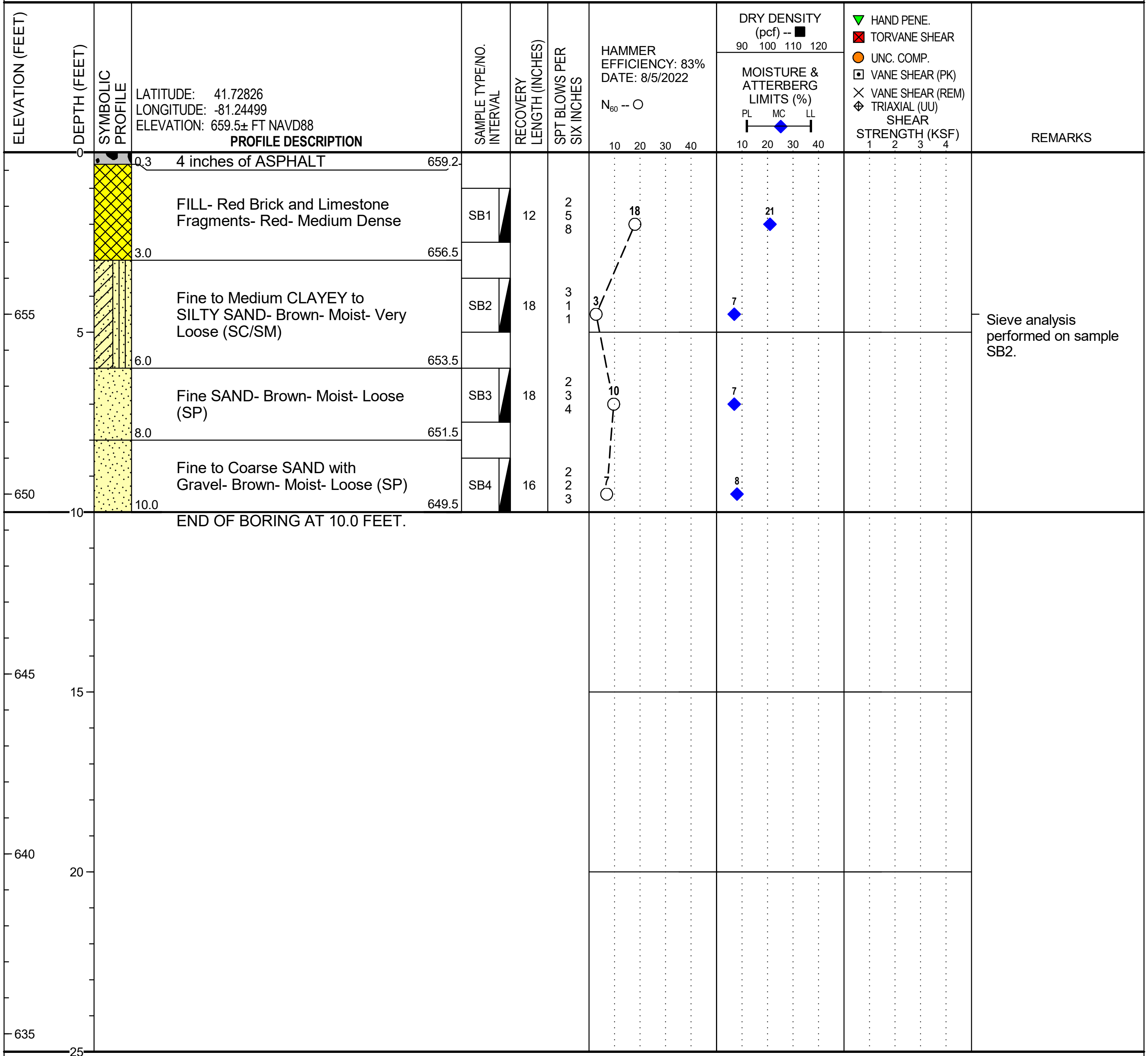
PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 4" Hollow-stem Augers W/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72826
LONGITUDE: -81.24499
ELEVATION: 659.5± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022



DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)	REMARKS
0.3	659.2	4 inches of ASPHALT						
3.0	656.5	FILL- Red Brick and Limestone Fragments- Red- Medium Dense	SB1	12	2 5 8	18	21	
6.0	653.5	Fine to Medium CLAYEY to SILTY SAND- Brown- Moist- Very Loose (SC/SM)	SB2	18	3 1 1	3	7	Sieve analysis performed on sample SB2.
8.0	651.5	Fine SAND- Brown- Moist- Loose (SP)	SB3	18	2 3 4	10	7	
10.0	649.5	Fine to Coarse SAND with Gravel- Brown- Moist- Loose (SP)	SB4	16	2 2 3	7	8	

END OF BORING AT 10.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

SME

BORING B17

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00

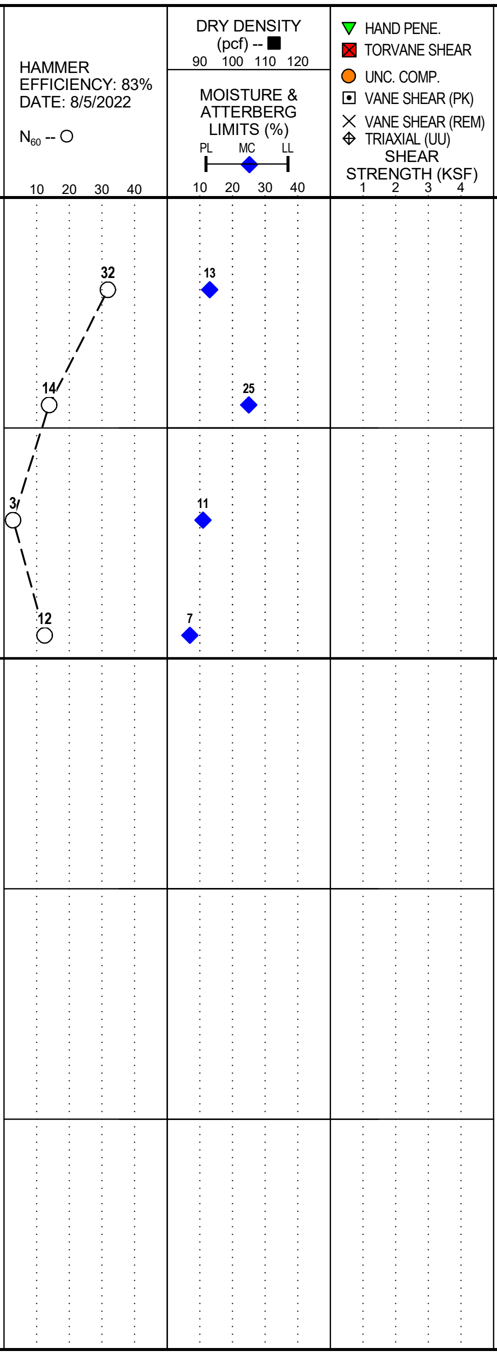
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 4" Hollow-stem Augers W/ AW Rod

DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72769
LONGITUDE: -81.24503
ELEVATION: 660.5± FT NAVD88

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
0.8	10 inches of TOPSOIL	659.7			
5.5	FILL- Fine to Coarse SAND with Gravel- Frequent Brick Fragments- Brown and Red- Moist- Dense to Medium Dense (SP)	655.0	SB1 SB2	14 18	3 3 20 11 6 4
8.0	Fine SAND- Brown- Moist- Very Loose (SP)	652.5	SB3	18	1 1 1
10.0	Fine to Coarse SAND with Gravel- Brown and Gray- Moist- Medium Dense (SP)	650.5	SB4	18	3 4 5
	END OF BORING AT 10.0 FEET.				



REMARKS

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

10/20/23 2:14:50 PM

SME

BORING B18

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

DATE STARTED: 8/25/23 **COMPLETED:** 8/25/23 **BORING METHOD:** 4" Hollow-stem Augers W/ AW Rod

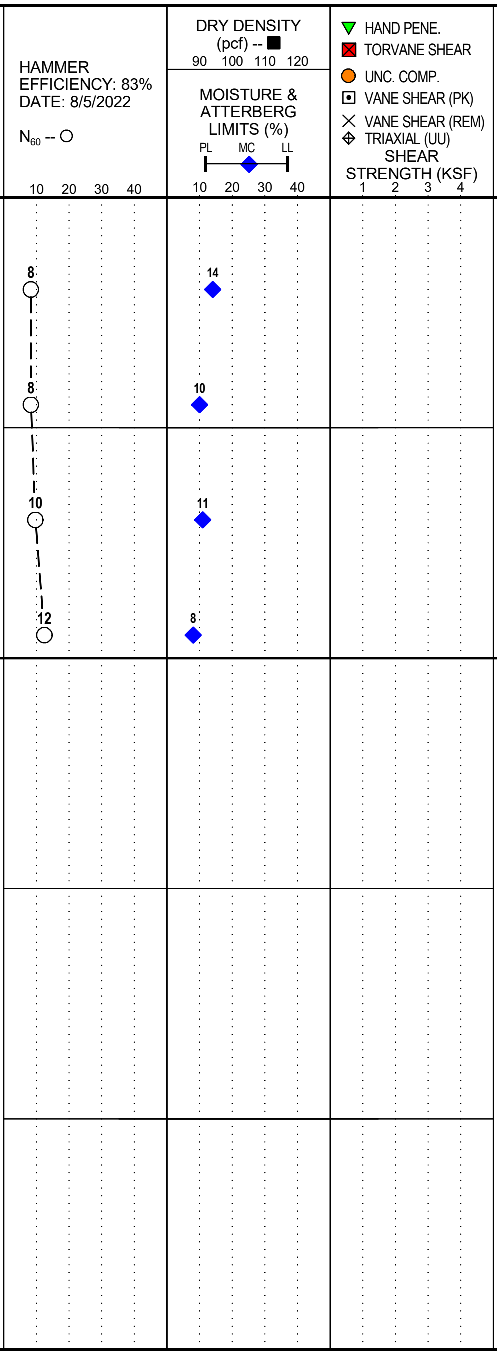
DRILLER: EP/ SS **RIG NO.:** 635 (CME 55 ATV) **LOGGED BY:** BAM **CHECKED BY:** TPO

LATITUDE: 41.72869
LONGITUDE: -81.24460
ELEVATION: 658.5± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.1	1 inch of ASPHALT	658.4
0.3	4 inches of SAND & GRAVEL	658.2
10.0	Fine to Medium SAND- Trace Gravel- Brown- Moist- Loose to Medium Dense (SP)	648.5
	END OF BORING AT 10.0 FEET.	

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)
SB1	18	3 3 3	8	14
SB2	18	3 3 3	8	10
SB3	16	2 3 4	10	11
SB4	18	3 4 5	12	8



REMARKS

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

10/20/23 2:14:50 PM

BORING B19

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

DATE STARTED: 8/25/23 **COMPLETED:** 8/25/23 **BORING METHOD:** 4" Hollow-stem Augers W/ AW Rod

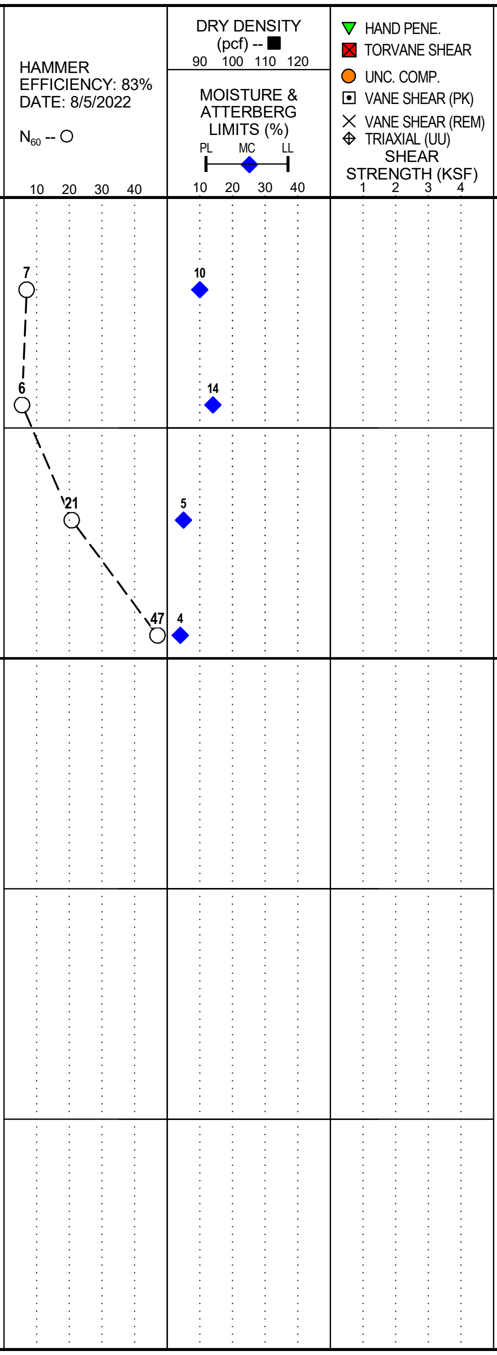
DRILLER: EP/ SS **RIG NO.:** 635 (CME 55 ATV) **LOGGED BY:** BAM **CHECKED BY:** TPO

LATITUDE: 41.72588
LONGITUDE: -81.24612
ELEVATION: 668.7± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)	REMARKS
0 – 1.0	667.7	12 inches of ASPHALT						
1.0 – 3.0	665.7	FILL- Fine SAND- Occasional Brick Fragments- Brown- Moist- Loose (SP)	SB1	18	3 3 2	7	10	
3.0 – 5.5	663.2	FILL- Crushed LIMESTONE, Sand, and Gravel- Gray- Moist- Loose (SP/GP)	SB2	10	1 1 3	6	14	
5.5 – 10.0	658.7	Fine to Coarse SAND with Gravel- Brown- Moist- Medium Dense to Dense (SP)	SB3	14	3 7 8	21	5	
			SB4		10 10 24	47	4	

END OF BORING AT 10.0 FEET.



ELEVATION (FEET): 665, 660, 655, 650, 645
DEPTH (FEET): 0, 5, 10, 15, 20, 25

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug after backfilling the borehole.

10/20/23 2:14:51 PM

BORING B20

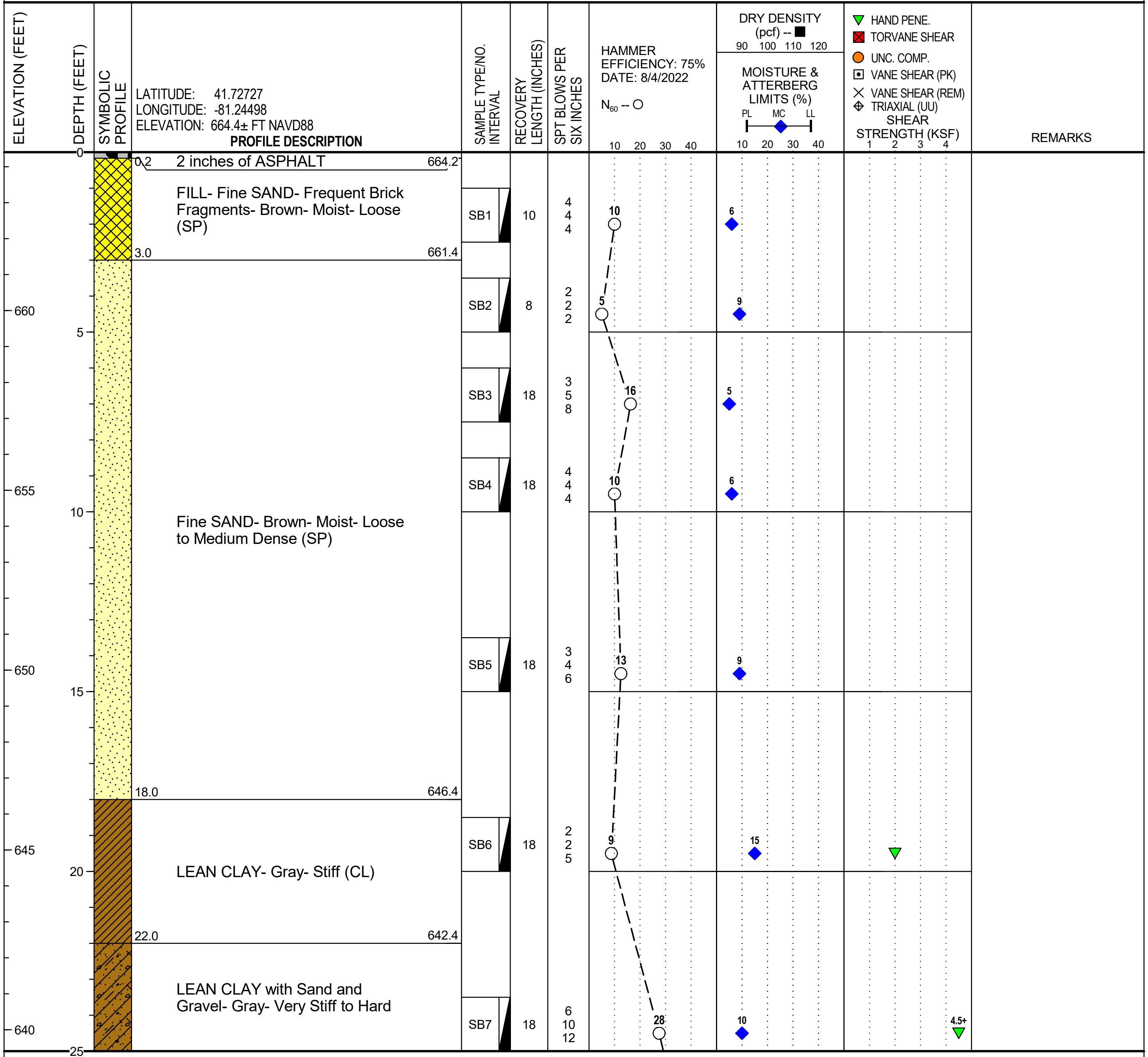
PAGE 1 OF 2

BORING DEPTH: 38.75 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 3-3/4" Hollow-stem Auger
DRILLER: RM/ JH/ LP/ SS
RIG NO.: 290 (CME 45B)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72727
LONGITUDE: -81.24498
ELEVATION: 664.4± FT NAVD88

HAMMER EFFICIENCY: 75%
DATE: 8/4/2022



DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)
0.2	2 inches of ASPHALT	664.2
3.0	FILL- Fine SAND- Frequent Brick Fragments- Brown- Moist- Loose (SP)	661.4
18.0	Fine SAND- Brown- Moist- Loose to Medium Dense (SP)	646.4
22.0	LEAN CLAY- Gray- Stiff (CL)	642.4
	LEAN CLAY with Sand and Gravel- Gray- Very Stiff to Hard	

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MC (%)	SHEAR STRENGTH (KSF)
SB1	10	4 4 4	10	6	
SB2	8	2 2 2	5	9	
SB3	18	3 5 8	16	5	
SB4	18	4 4 4	10	6	
SB5	18	3 4 6	13	9	
SB6	18	2 2 5	9	15	
SB7	18	6 10 12	28	10	4.5+

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

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BORING B20

PAGE 2 OF 2

BORING DEPTH: 38.75 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC) **PROJECT NUMBER:** 093528.00

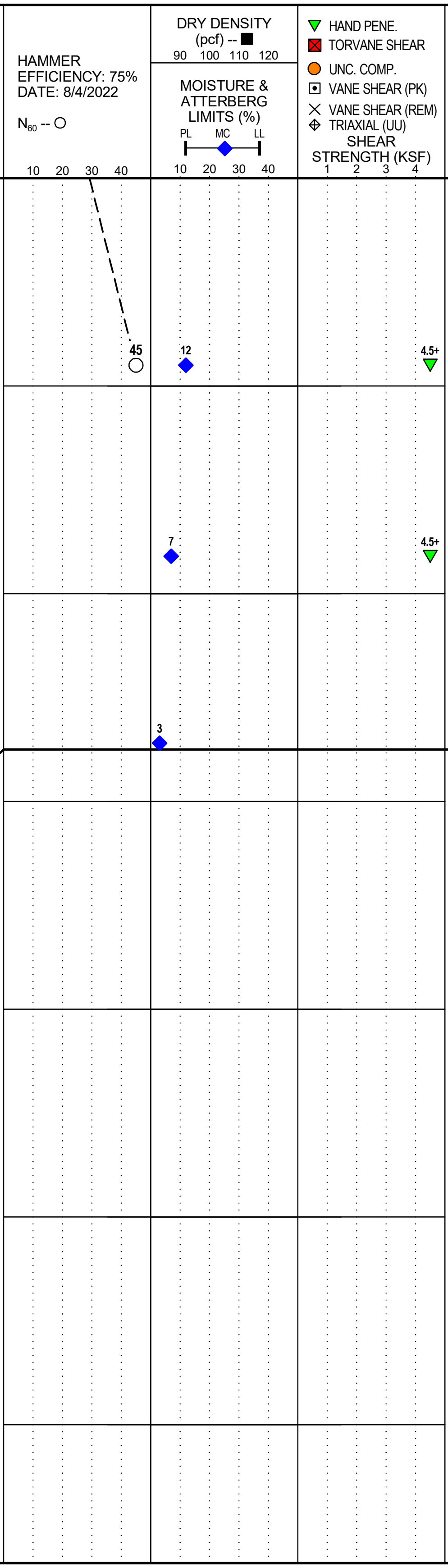
CLIENT: Lake County Board of Commissioners **PROJECT LOCATION:** Painesville, Ohio

LATITUDE: 41.72727
LONGITUDE: -81.24498
ELEVATION: 664.4± FT NAVD88

HAMMER EFFICIENCY: 75%
DATE: 8/4/2022

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%) MC	SHEAR STRENGTH (KSF) HAND PENE.	REMARKS
	25–38.0	LEAN CLAY with Sand and Gravel- Gray- Very Stiff to Hard *(continued)*	SB8	18	12 14 22	45	12	4.5+	
			SB9	9	38 50/3"		7	4.5+	
626.4–625.7	38.0–38.8	Weathered SHALE- Gray- Medium Hard	SB10	2	50/3"		3		

END OF BORING AT 38.8 FEET.



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SME

BORING B21

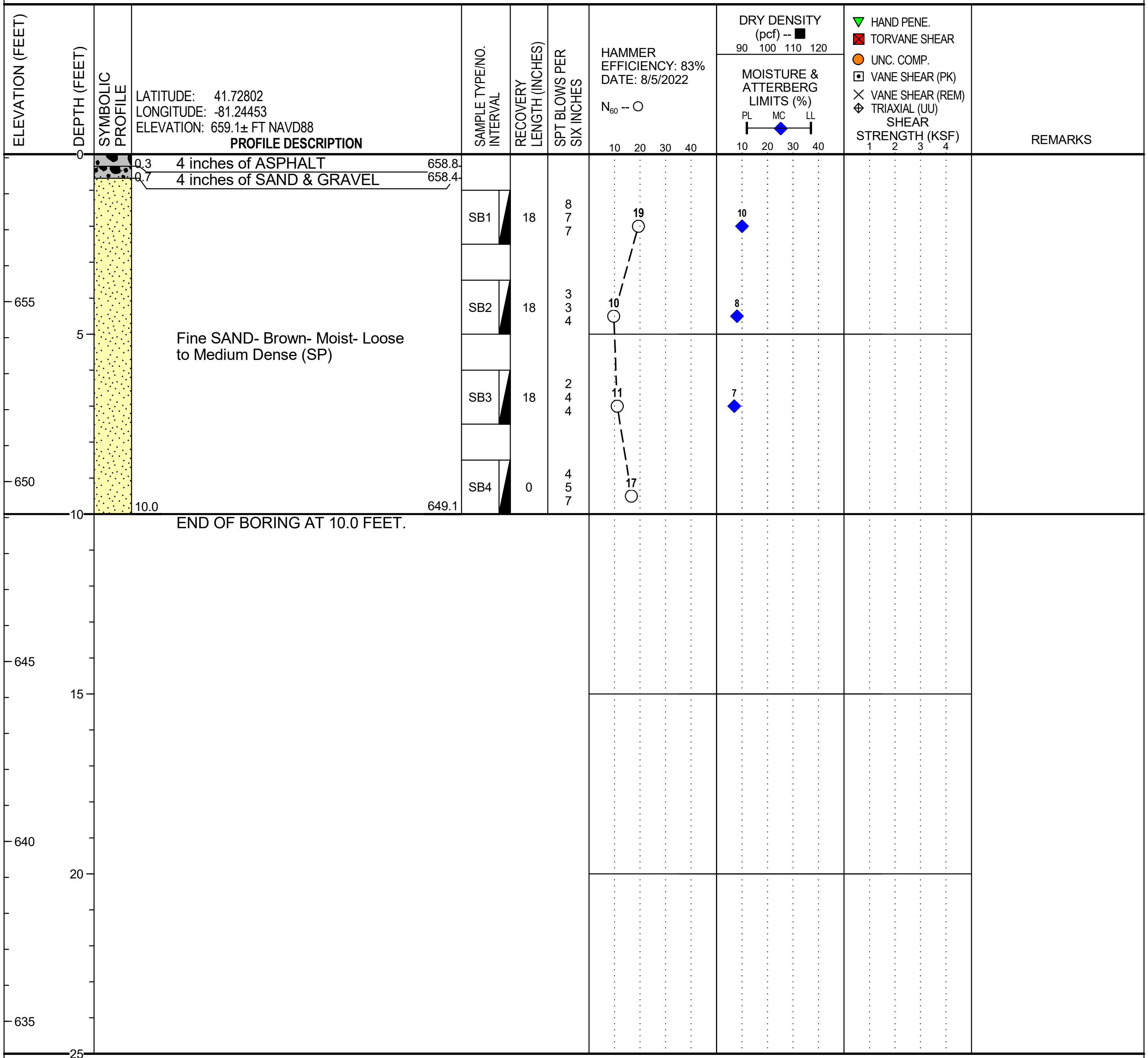
PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio
DATE STARTED: 8/24/23
COMPLETED: 8/24/23
BORING METHOD: 4" Hollow-stem Augers W/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO

LATITUDE: 41.72802
LONGITUDE: -81.24453
ELEVATION: 659.1± FT NAVD88

HAMMER EFFICIENCY: 83%
DATE: 8/5/2022



DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)
0.3	658.8	4 inches of ASPHALT					
0.7	658.4	4 inches of SAND & GRAVEL					
		Fine SAND- Brown- Moist- Loose to Medium Dense (SP)	SB1	18	8 7 7	19	10
			SB2	18	3 3 4	10	8
			SB3	18	2 4 4	11	7
10.0	649.1		SB4	0	4 5 7	17	

END OF BORING AT 10.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

10/20/23 2:14:54 PM

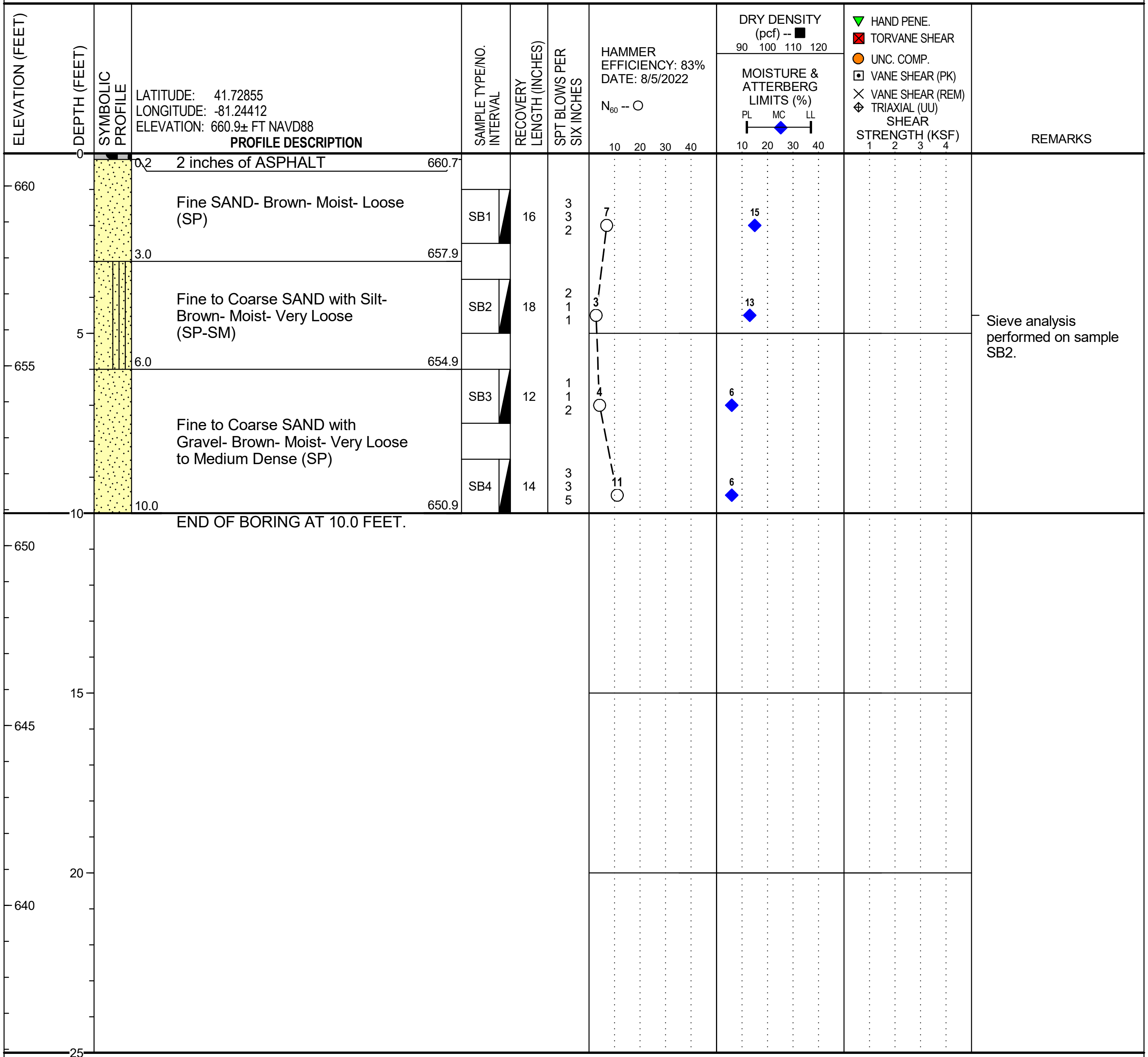
BORING B22

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Lake County Ohio Public Safety Center (LCOPSC)
PROJECT NUMBER: 093528.00
CLIENT: Lake County Board of Commissioners
PROJECT LOCATION: Painesville, Ohio

DATE STARTED: 8/25/23
COMPLETED: 8/25/23
BORING METHOD: 4" Hollow-stem Augers W/ AW Rod
DRILLER: EP/ SS
RIG NO.: 635 (CME 55 ATV)
LOGGED BY: BAM
CHECKED BY: TPO



LATITUDE: 41.72855
LONGITUDE: -81.24412
ELEVATION: 660.9± FT NAVD88

DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N60	MC	REMARKS
0.2	2 inches of ASPHALT	660.7						
3.0	Fine SAND- Brown- Moist- Loose (SP)	657.9	SB1	16	3 3 2	7	15	
6.0	Fine to Coarse SAND with Silt- Brown- Moist- Very Loose (SP-SM)	654.9	SB2	18	2 1 1	3	13	Sieve analysis performed on sample SB2.
			SB3	12	1 1 2	4	6	
10.0	Fine to Coarse Sand with Gravel- Brown- Moist- Very Loose to Medium Dense (SP)	650.9	SB4	14	3 3 5	11	6	

END OF BORING AT 10.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Surface capped with EPCO hole plug and cold patch after backfilling the borehole.

Lake County Public Safety - GEO
Painesville, Ohio

SME PROJECT #: 093528.00
October 10, 2023

B-3

Run#:	Depth		Recovery		RQD	
RC-1	33.5’	38.5’	60/60	100%	15/60	25%
RC-2	38.5’	43.5’	60/60	100%	31/60	52%

Lake County Public Safety - GEO

Lake County Public Safety - GEO
Painesville, Ohio

SME PROJECT #: 093528.00
October 10, 2023

B-7

Run#:	Depth		Recovery		RQD	
RC-1	39’	44’	60/60	100%	47/60	78%
RC-2	44’	49’	60/60	100%	27/60	45%

Lake County Public Safety - GEO

SME

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B9
SURFACE ELEV. (FT): 655.8

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	6	6	ASPHALT PAVEMENT	
6	8	2	SAND and GRAVEL	
8	35	27	Fine SAND - Brown - Moist - Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

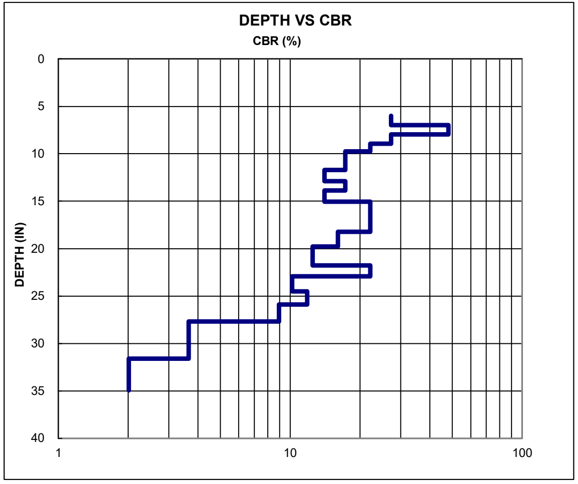
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 6 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	380	0							
3	405	25	8	1	7.0	27.2	Good	Subgrade	
5	430	25	5	1	8.0	48.1	Good	Subgrade	
3	455	25	8	1	9.0	27.2	Good	Subgrade	
2	475	20	10	1	9.7	22.2	Good	Subgrade	
2	500	25	13	1	10.7	17.3	Good	Subgrade	
2	525	25	13	1	11.7	17.3	Good	Subgrade	
2	555	30	15	1	12.9	14.1	Good	Subgrade	
2	580	25	13	1	13.9	17.3	Good	Subgrade	
2	610	30	15	1	15.1	14.1	Good	Subgrade	
3	640	30	10	1	16.2	22.2	Good	Subgrade	
2	660	20	10	1	17.0	22.2	Good	Subgrade	
3	690	30	10	1	18.2	22.2	Good	Subgrade	
3	730	40	13	1	19.8	16.0	Good	Subgrade	
3	780	50	17	1	21.7	12.5	Good	Subgrade	
3	810	30	10	1	22.9	22.2	Good	Subgrade	
2	850	40	20	1	24.5	10.2	Good	Subgrade	
2	885	35	18	1	25.9	11.8	Good	Subgrade	
2	930	45	23	1	27.7	8.9	Marginal	Subgrade	18.3
2	1030	100	50	1	31.6	3.7	Poor	Subgrade	
1	1115	85	85	1	34.9	2.0	Very Poor	Subgrade	2.9

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B10
SURFACE ELEV. (FT): 656.0

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	6	6	ASPHALT PAVEMENT	
6	9	3	SAND and GRAVEL	
9	28	19	FILL - Fine to Coarse SAND with Gravel (Sandstone Fragments) - Occasional Brick Fragments - Brown - Moist - Medium Dense (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

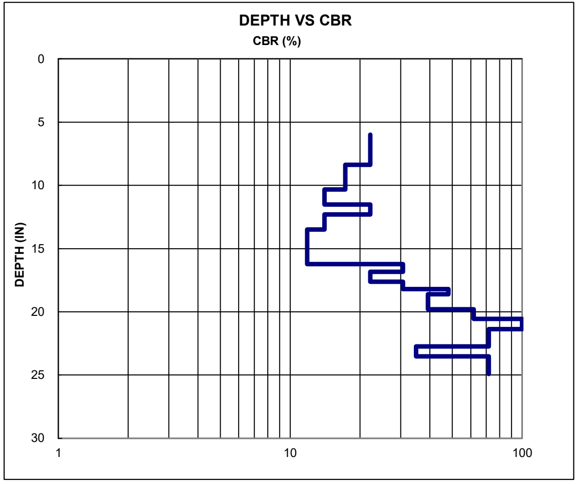
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 6 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	480	0							
2	500	20	10	1	6.8	22.2	Good	Subgrade	
2	520	20	10	1	7.6	22.2	Good	Subgrade	
2	540	20	10	1	8.4	22.2	Good	Subgrade	
2	565	25	13	1	9.3	17.3	Good	Subgrade	
2	590	25	13	1	10.3	17.3	Good	Subgrade	
2	620	30	15	1	11.5	14.1	Good	Subgrade	
2	640	20	10	1	12.3	22.2	Good	Subgrade	
2	670	30	15	1	13.5	14.1	Good	Subgrade	
2	705	35	18	1	14.9	11.8	Good	Subgrade	
2	740	35	18	1	16.2	11.8	Good	Subgrade	
2	755	15	8	1	16.8	30.6	Good	Subgrade	
2	775	20	10	1	17.6	22.2	Good	Subgrade	
2	790	15	8	1	18.2	30.6	Good	Subgrade	
2	800	10	5	1	18.6	48.1	Good	Subgrade	
5	830	30	6	1	19.8	39.3	Good	Subgrade	
5	850	20	4	1	20.6	61.8	Good	Subgrade	
10	860	10	1	1	21.0	100.0	Good	Subgrade	
10	870	10	1	1	21.4	100.0	Good	Subgrade	
10	905	35	4	1	22.7	71.8	Good	Subgrade	
3	925	20	7	1	23.5	34.9	Good	Subgrade	
10	960	35	4	1	24.9	71.8	Good	Subgrade	
3	965	5	2	1	25.1	100.0	Good	Subgrade	
3	975	10	3	1	25.5	75.8	Good	Subgrade	
3	990	15	5	1	26.1	48.1	Good	Subgrade	
2	1005	15	8	1	26.7	30.6	Good	Subgrade	
2	1025	20	10	1	27.5	22.2	Good	Subgrade	35.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

SME

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B11
SURFACE ELEV. (FT): 657.1

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	12	12	TOPSOIL	
12	35	23	FILL - SAND - Trace Gravel and Occasional Brick Fragments - Brown - Moist - Medium Dense to Very Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

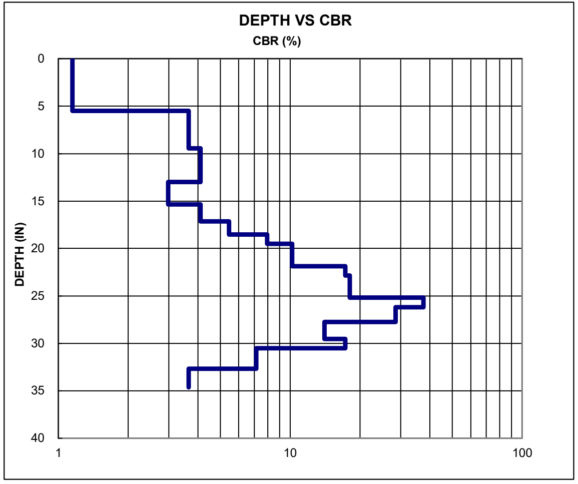
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 0 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	160	0							
1	300	140	140	1	5.5	1.2	Very Poor	Topsoil	
2	400	100	50	1	9.4	3.7	Poor	Topsoil	
1	445	45	45	1	11.2	4.1	Poor	Topsoil	
1	490	45	45	1	13.0	4.1	Poor	Topsoil	2.7
1	550	60	60	1	15.4	3.0	Very Poor	Subgrade	
1	595	45	45	1	17.1	4.1	Poor	Subgrade	3.5
1	630	35	35	1	18.5	5.4	Marginal	Subgrade	
1	655	25	25	1	19.5	7.9	Marginal	Subgrade	
1	675	20	20	1	20.3	10.2	Good	Subgrade	
2	715	40	20	1	21.9	10.2	Good	Subgrade	
2	740	25	13	1	22.8	17.3	Good	Subgrade	
5	800	60	12	1	25.2	18.1	Good	Subgrade	
4	825	25	6	1	26.2	37.5	Good	Subgrade	
5	865	40	8	1	27.8	28.4	Good	Subgrade	
3	910	45	15	1	29.5	14.1	Good	Subgrade	
2	935	25	13	1	30.5	17.3	Good	Subgrade	
2	990	55	28	1	32.7	7.1	Marginal	Subgrade	
1	1040	50	50	1	34.6	3.7	Poor	Subgrade	14

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/24/23
BY: EP/SS

BORING: B12
SURFACE ELEV. (FT): 657.5

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	3	3	ASPHALT PAVEMENT	
3	6	3	SAND and GRAVEL	
6	28	22	FILL - Fine to Coarse SAND with Gravel (Limestone Fragments) - Brown and Gray - Moist - Medium Dense (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

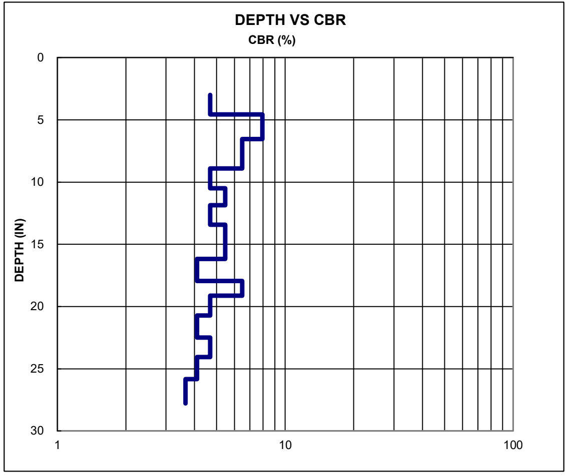
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 3 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	450	0							
1	490	40	40	1	4.6	4.7	Poor	Subgrade	
1	515	25	25	1	5.6	7.9	Marginal	Subgrade	
1	540	25	25	1	6.5	7.9	Marginal	Subgrade	
1	570	30	30	1	7.7	6.5	Marginal	Subgrade	
1	600	30	30	1	8.9	6.5	Marginal	Subgrade	
1	640	40	40	1	10.5	4.7	Poor	Subgrade	
1	675	35	35	1	11.9	5.4	Marginal	Subgrade	
1	715	40	40	1	13.4	4.7	Poor	Subgrade	
1	750	35	35	1	14.8	5.4	Marginal	Subgrade	
1	785	35	35	1	16.2	5.4	Marginal	Subgrade	
1	830	45	45	1	18.0	4.1	Poor	Subgrade	
1	860	30	30	1	19.1	6.5	Marginal	Subgrade	5.6
1	900	40	40	1	20.7	4.7	Poor	Subgrade	
1	945	45	45	1	22.5	4.1	Poor	Subgrade	
1	985	40	40	1	24.1	4.7	Poor	Subgrade	
1	1030	45	45	1	25.8	4.1	Poor	Subgrade	
1	1080	50	50	1	27.8	3.7	Poor	Subgrade	4.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

SME

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B13
SURFACE ELEV. (FT): 658.8

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	2	2	LIMESTONE GRAVEL	
2	21	19	Fine SAND - Trace Gravel - Brown - Moist - Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

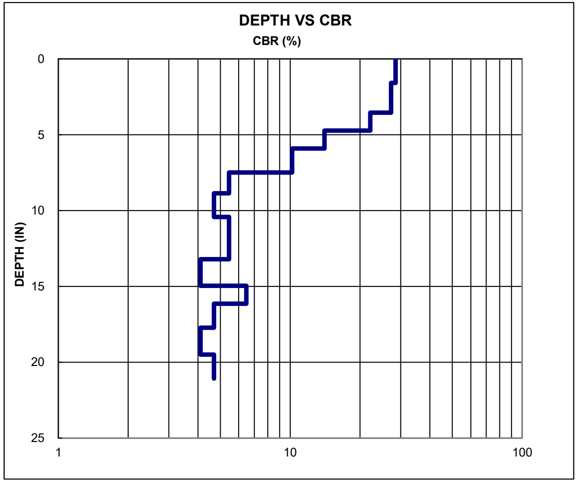
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 0 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	450	0							
5	490	40	8	1	1.6	28.4	Good	Subgrade	
3	515	25	8	1	2.6	27.2	Good	Subgrade	
3	540	25	8	1	3.5	27.2	Good	Subgrade	
3	570	30	10	1	4.7	22.2	Good	Subgrade	
2	600	30	15	1	5.9	14.1	Good	Subgrade	
2	640	40	20	1	7.5	10.2	Good	Subgrade	21
1	675	35	35	1	8.9	5.4	Marginal	Subgrade	
1	715	40	40	1	10.4	4.7	Poor	Subgrade	
1	750	35	35	1	11.8	5.4	Marginal	Subgrade	
1	785	35	35	1	13.2	5.4	Marginal	Subgrade	
1	830	45	45	1	15.0	4.1	Poor	Subgrade	
1	860	30	30	1	16.1	6.5	Marginal	Subgrade	5.2
1	900	40	40	1	17.7	4.7	Poor	Subgrade	
1	945	45	45	1	19.5	4.1	Poor	Subgrade	
1	985	40	40	1	21.1	4.7	Poor	Subgrade	4.5

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/24/23
BY: EP/SS

BORING: B14
SURFACE ELEV. (FT): 656.8

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	2	2	ASPHALT PAVEMENT	
2	30	28	FILL - Fine SAND - Frequent Cinders - Black - Moist - Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

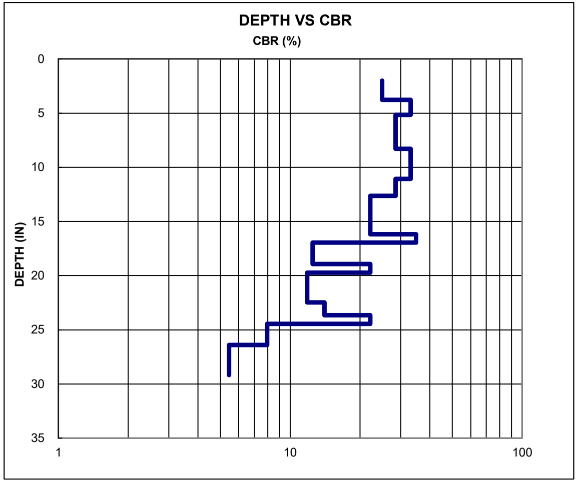
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 2 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	380	0							
5	425	45	9	1	3.8	24.9	Good	Subgrade	
5	460	35	7	1	5.1	33.0	Good	Subgrade	
5	500	40	8	1	6.7	28.4	Good	Subgrade	
5	540	40	8	1	8.3	28.4	Good	Subgrade	
5	575	35	7	1	9.7	33.0	Good	Subgrade	
5	610	35	7	1	11.1	33.0	Good	Subgrade	
5	650	40	8	1	12.6	28.4	Good	Subgrade	
3	680	30	10	1	13.8	22.2	Good	Subgrade	
3	710	30	10	1	15.0	22.2	Good	Subgrade	
3	740	30	10	1	16.2	22.2	Good	Subgrade	
3	760	20	7	1	17.0	34.9	Good	Subgrade	
3	810	50	17	1	18.9	12.5	Good	Subgrade	
2	830	20	10	1	19.7	22.2	Good	Subgrade	
2	865	35	18	1	21.1	11.8	Good	Subgrade	
2	900	35	18	1	22.5	11.8	Good	Subgrade	
2	930	30	15	1	23.7	14.1	Good	Subgrade	
2	950	20	10	1	24.4	22.2	Good	Subgrade	
2	1000	50	25	1	26.4	7.9	Marginal	Subgrade	
2	1070	70	35	1	29.2	5.4	Marginal	Subgrade	20.6

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/24/23
BY: EP/SS

BORING: B16
SURFACE ELEV. (FT): 659.5

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	4	4	ASPHALT PAVEMENT	
4	35	31	FILL - Red Brick and Limestone Fragements - Red - Medium Dense	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

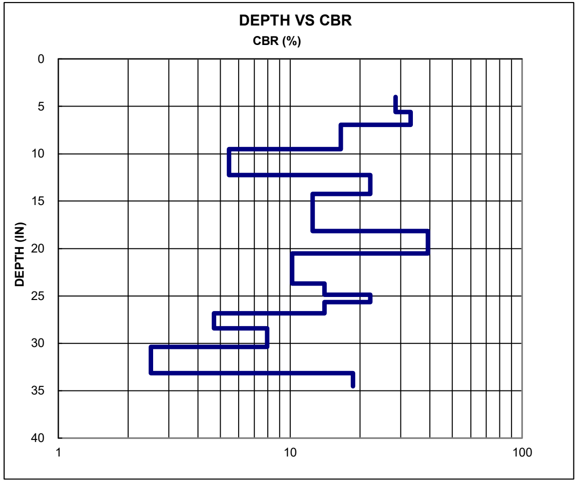
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 4 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	270	0							
5	310	40	8	1	5.6	28.4	Good	Subgrade	
5	345	35	7	1	7.0	33.0	Good	Subgrade	
5	410	65	13	1	9.5	16.5	Good	Subgrade	
2	480	70	35	1	12.3	5.4	Marginal	Subgrade	
2	500	20	10	1	13.1	22.2	Good	Subgrade	
3	530	30	10	1	14.2	22.2	Good	Subgrade	
3	580	50	17	1	16.2	12.5	Good	Subgrade	
3	630	50	17	1	18.2	12.5	Good	Subgrade	
10	690	60	6	1	20.5	39.3	Good	Subgrade	
2	730	40	20	1	22.1	10.2	Good	Subgrade	
2	770	40	20	1	23.7	10.2	Good	Subgrade	
2	800	30	15	1	24.9	14.1	Good	Subgrade	
2	820	20	10	1	25.7	22.2	Good	Subgrade	
2	850	30	15	1	26.8	14.1	Good	Subgrade	
1	890	40	40	1	28.4	4.7	Poor	Subgrade	
2	940	50	25	1	30.4	7.9	Marginal	Subgrade	
1	1010	70	70	1	33.1	2.5	Very Poor	Subgrade	
3	1045	35	12	1	34.5	18.6	Good	Subgrade	15.5

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/24/23
BY: EP/SS

BORING: B17
SURFACE ELEV. (FT): 660.5

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	10	10	TOPSOIL	
10	33	23	FILL - Fine to Coarse SAND with Gravel - Frequent Brick Fragments - Brown and Red - Moist - Dense to Medium Dense (SP)	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

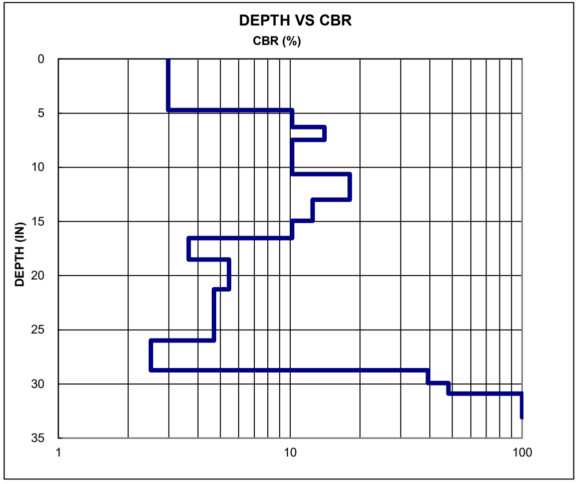
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 0 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	180	0							
2	300	120	60	1	4.7	3.0	Very Poor	Topsoil	
2	340	40	20	1	6.3	10.2	Good	Topsoil	
2	370	30	15	1	7.5	14.1	Good	Topsoil	
2	410	40	20	1	9.1	10.2	Good	Topsoil	
2	450	40	20	1	10.6	10.2	Good	Topsoil	7.4
5	510	60	12	1	13.0	18.1	Good	Subgrade	
3	560	50	17	1	15.0	12.5	Good	Subgrade	
2	600	40	20	1	16.5	10.2	Good	Subgrade	14.1
1	650	50	50	1	18.5	3.7	Poor	Subgrade	
2	720	70	35	1	21.3	5.4	Marginal	Subgrade	
2	800	80	40	1	24.4	4.7	Poor	Subgrade	
1	840	40	40	1	26.0	4.7	Poor	Subgrade	
1	910	70	70	1	28.7	2.5	Very Poor	Subgrade	4.2
5	940	30	6	1	29.9	39.3	Good	Subgrade	
5	965	25	5	1	30.9	48.1	Good	Subgrade	
8	980	15	2	1	31.5	100.0	Good	Subgrade	
10	1000	20	2	1	32.3	100.0	Good	Subgrade	
10	1020	20	2	1	33.1	100.0	Good	Subgrade	71.6

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

SME

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B18
SURFACE ELEV. (FT): 658.5

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	1	1	ASPHALT PAVEMENT	
1	5	4	SAND and GRAVEL	
5	29	24	Fine to Medium SAND - Trace Gravel - Brown - Moist - Loose to Medium Dense (SP)	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

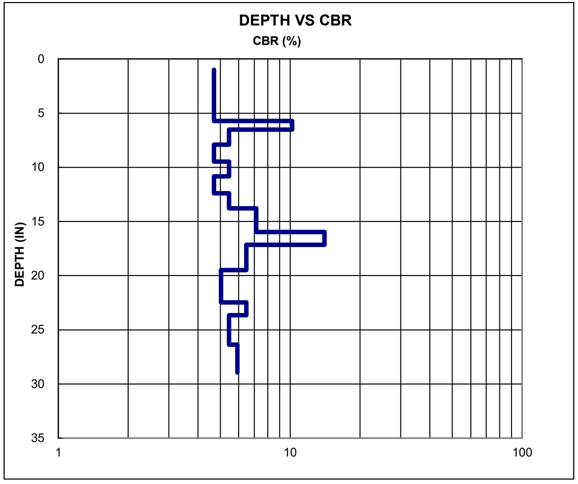
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 1 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	330	0							
2	410	80	40	1	4.1	4.7	Very Poor	Agg Base	4.7
1	450	40	40	1	5.7	4.7	Poor	Sand	
1	470	20	20	1	6.5	10.2	Good	Sand	
1	505	35	35	1	7.9	5.4	Marginal	Sand	
1	545	40	40	1	9.5	4.7	Poor	Sand	
1	580	35	35	1	10.8	5.4	Marginal	Sand	
1	620	40	40	1	12.4	4.7	Poor	Sand	
1	655	35	35	1	13.8	5.4	Marginal	Sand	
2	710	55	28	1	16.0	7.1	Marginal	Sand	
2	740	30	15	1	17.1	14.1	Good	Sand	
2	800	60	30	1	19.5	6.5	Marginal	Sand	
2	875	75	38	1	22.5	5.0	Marginal	Sand	
1	905	30	30	1	23.6	6.5	Marginal	Sand	
2	975	70	35	1	26.4	5.4	Marginal	Sand	
2	1040	65	33	1	29.0	5.9	Marginal	Sand	6.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B19
SURFACE ELEV. (FT): 668.7

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	12	12	ASPHALT PAVEMENT	
12	36	24	FILL - Fine SAND - Occasional Brick Fragments - Brown - Moist - Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

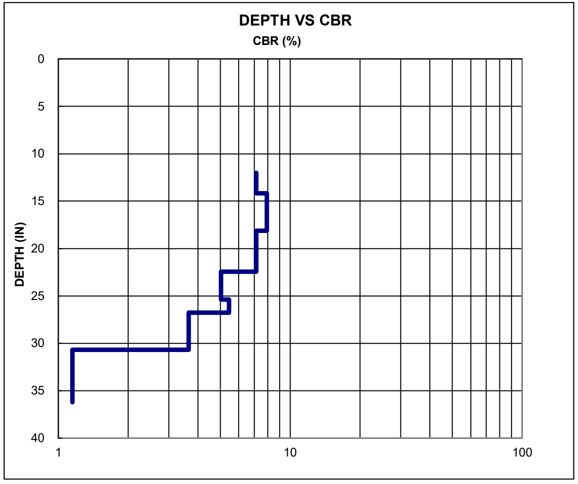
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 12 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	605	0							
2	660	55	28	1	14.2	7.1	Marginal	Subgrade	
2	710	50	25	1	16.1	7.9	Marginal	Subgrade	
2	760	50	25	1	18.1	7.9	Marginal	Subgrade	
2	815	55	28	1	20.3	7.1	Marginal	Subgrade	
2	870	55	28	1	22.4	7.1	Marginal	Subgrade	
2	945	75	38	1	25.4	5.0	Marginal	Subgrade	
1	980	35	35	1	26.8	5.4	Marginal	Subgrade	6.8
1	1030	50	50	1	28.7	3.7	Poor	Subgrade	
1	1080	50	50	1	30.7	3.7	Poor	Subgrade	
1	1220	140	140	1	36.2	1.2	Very Poor	Subgrade	2.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

SME

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/24/23
BY: EP/SS

BORING: B21
SURFACE ELEV. (FT): 659.1

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	4	4	ASPHALT PAVEMENT	
4	8	4	SAND and GRAVEL	
8	35	27	Fine SAND - Brown - Moist - Loose to Medium Dense (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

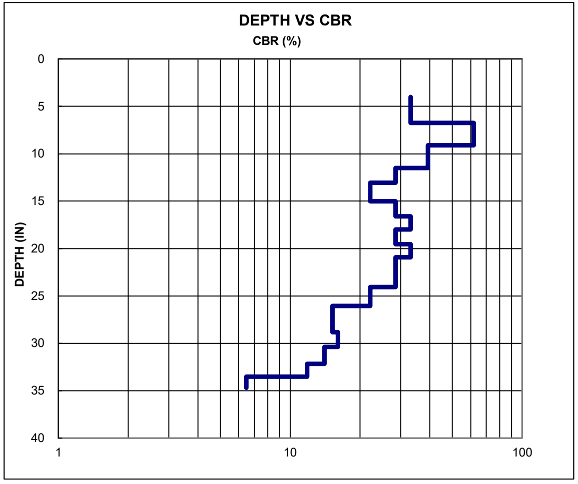
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 4 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	270	0							
5	305	35	7	1	5.4	33.0	Good	Subgrade	
5	340	35	7	1	6.8	33.0	Good	Subgrade	
5	360	20	4	1	7.5	61.8	Good	Subgrade	
10	400	40	4	1	9.1	61.8	Good	Subgrade	
10	460	60	6	1	11.5	39.3	Good	Subgrade	
5	500	40	8	1	13.1	28.4	Good	Subgrade	
5	550	50	10	1	15.0	22.2	Good	Subgrade	
5	590	40	8	1	16.6	28.4	Good	Subgrade	
5	625	35	7	1	18.0	33.0	Good	Subgrade	
5	665	40	8	1	19.6	28.4	Good	Subgrade	
5	700	35	7	1	20.9	33.0	Good	Subgrade	
5	740	40	8	1	22.5	28.4	Good	Subgrade	
5	780	40	8	1	24.1	28.4	Good	Subgrade	
5	830	50	10	1	26.0	22.2	Good	Subgrade	
5	900	70	14	1	28.8	15.2	Good	Subgrade	
3	940	40	13	1	30.4	16.0	Good	Subgrade	
3	985	45	15	1	32.1	14.1	Good	Subgrade	
2	1020	35	18	1	33.5	11.8	Good	Subgrade	
1	1050	30	30	1	34.7	6.5	Marginal	Subgrade	27.6

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

USACE DCP DATA

PROJECT NAME: Lake County Ohio Public Safety Center
PROJECT NO.: 093528.00
LOCATION: Painesville, Ohio
CLIENT: Lake County Commisioner's Office
COMPLETED: 8/25/23
BY: EP/SS

BORING: B22
SURFACE ELEV. (FT): 660.9

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in.		Layer Thickness, in.	Description	Comment
From	To			
0	2	2	ASPHALT PAVEMENT	
2	35	33	Fine SAND - Brown - Moist - Loose (SP)	
			See Note 1	

Depth to Groundwater From Ground Surface
Upon Completion: See Note 1

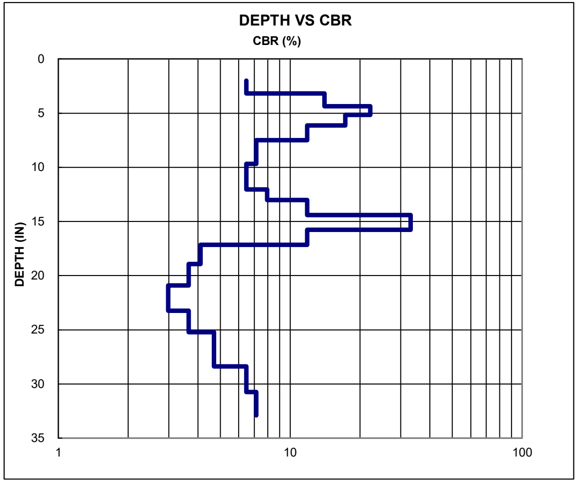
NOTES:
1) See attached boring logs for complete depths and descriptions of the soils encountered, and results of the field and laboratory tests

DCP TEST RESULTS

Depth to start of test from ex. ground surface: 2 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	230	0							
1	260	30	30	1	3.2	6.5	Marginal	Subgrade	
2	290	30	15	1	4.4	14.1	Good	Subgrade	
2	310	20	10	1	5.1	22.2	Good	Subgrade	
2	335	25	13	1	6.1	17.3	Good	Subgrade	
2	370	35	18	1	7.5	11.8	Good	Subgrade	
2	425	55	28	1	9.7	7.1	Marginal	Subgrade	
1	455	30	30	1	10.9	6.5	Marginal	Subgrade	
1	485	30	30	1	12.0	6.5	Marginal	Subgrade	
1	510	25	25	1	13.0	7.9	Marginal	Subgrade	
2	545	35	18	1	14.4	11.8	Good	Subgrade	
5	580	35	7	1	15.8	33.0	Good	Subgrade	
2	615	35	18	1	17.2	11.8	Good	Subgrade	12.6
1	660	45	45	1	18.9	4.1	Poor	Subgrade	
1	710	50	50	1	20.9	3.7	Poor	Subgrade	
1	770	60	60	1	23.3	3.0	Very Poor	Subgrade	
1	820	50	50	1	25.2	3.7	Poor	Subgrade	
1	860	40	40	1	26.8	4.7	Poor	Subgrade	
1	900	40	40	1	28.4	4.7	Poor	Subgrade	3.9
1	930	30	30	1	29.6	6.5	Marginal	Subgrade	
1	960	30	30	1	30.7	6.5	Marginal	Subgrade	
2	1015	55	28	1	32.9	7.1	Marginal	Subgrade	
1	1065	50	50	1	34.9	3.7	Poor	Subgrade	5.8

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer



*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.

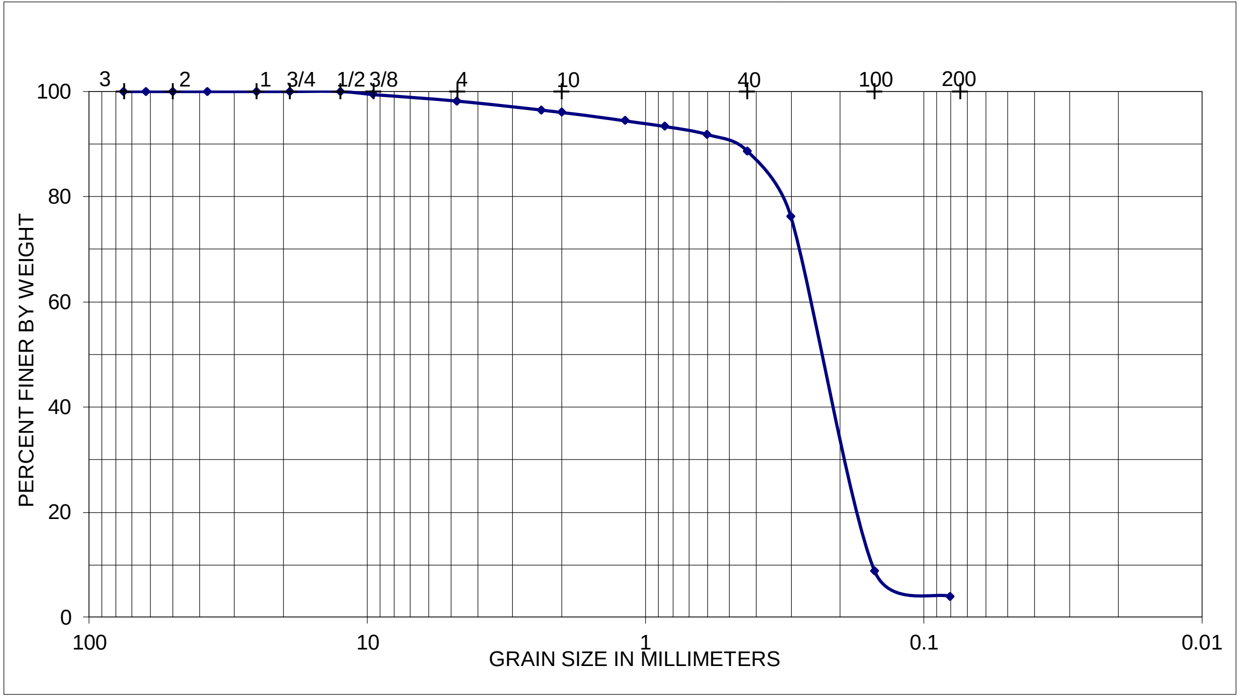
Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Sieve Analysis
ASTM D422

Project: Lake County Ohio Public Safety Cent
Location: 0
Project #: 093528.00
Date: 10/10/2023

Sample Description: Poorly graded SAND
Sample Location: B-3; 6' - 7.5'
Sample #: SB3



Sieve #	Sieve size, mm	Total Percent Passing	Total Percent Retained	Individual Percent Retained
3	75	100	0	0
2-1/2"	62.5	100	0	0
2"	50	100	0	0
1-1/2"	37.5	100	0	0
1"	25	100	0	0
3/4"	19	100	0	0
1/2"	12.5	100	0	0
3/8"	9.5	99	1	1
#4	4.75	98	2	1
#8	2.36	96	4	2
#10	2	96	4	0
#16	1.18	94	6	2
#20	0.85	93	7	1
#30	0.6	92	8	2
#40	0.43	89	11	3
#50	0.3	76	24	12
#100	0.15	9	91	67
#200	0.08	3.9	96.1	4.9

Initial Dry Mass Sample (gr): 213
Moisture Content Sample (%): 0

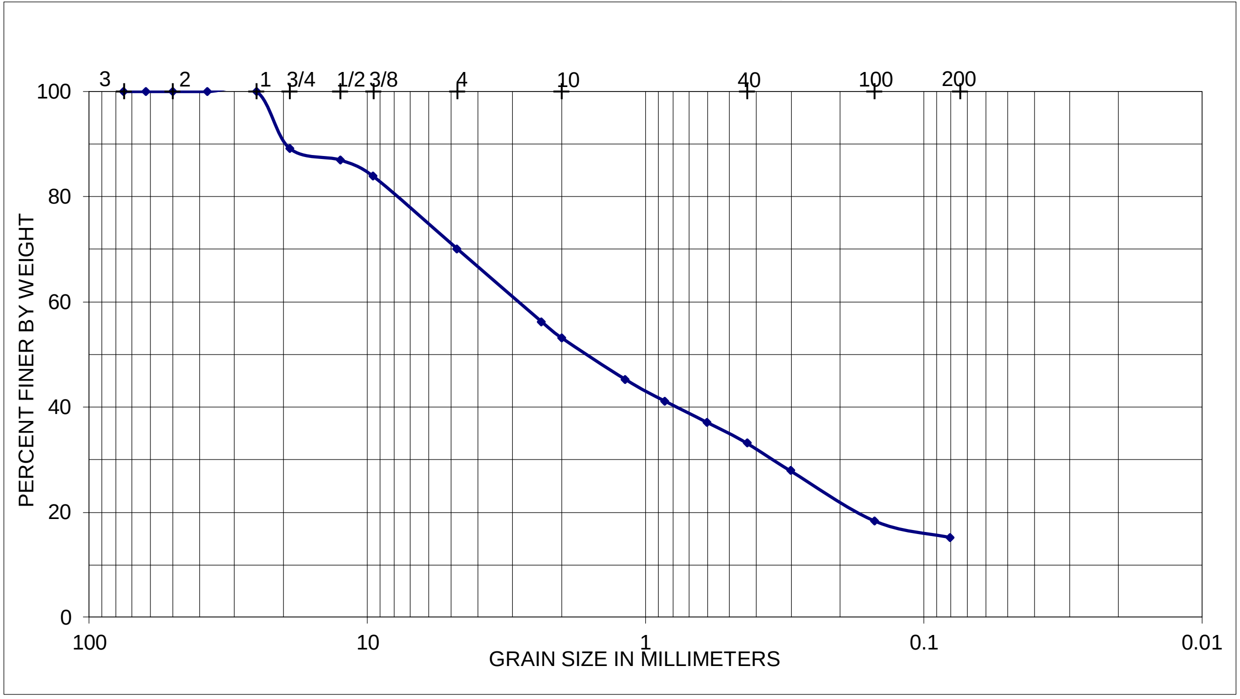
$D_{60} =$ 0.26
$D_{30} =$ 0.19
$D_{10} =$ 0.16
$C_u = D_{60}/D_{10} =$ 1.63
$C_c = (D_{30})^2/(D_{10} * D_{60}) =$ 0.87

9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Sieve Analysis
ASTM D422

Project: Lake County Ohio Public Safety Cent
Location: 0
Project #: 093528.00
Date: 10/10/2023

Sample Description: Silty clayey SAND with gravel
Sample Location: B-6; 8.5' - 10'
Sample #: SB4



Sieve #	**Sieve size, mm**	**Total Percent Passing**	**Total Percent Retained**	**Individual Percent Retained**
3	75	100	0	0
2-1/2"	62.5	100	0	0
2"	50	100	0	0
1-1/2"	37.5	100	0	0
1"	25	100	0	0
3/4"	19	89	11	11
1/2"	12.5	87	13	2
3/8"	9.5	84	16	3
#4	4.75	70	30	14
#8	2.36	56	44	14
#10	2	53	47	3
#16	1.18	45	55	8
#20	0.85	41	59	4
#30	0.6	37	63	4
#40	0.43	33	67	4
#50	0.3	28	72	5
#100	0.15	18	82	10
#200	0.08	15.1	84.9	3.2

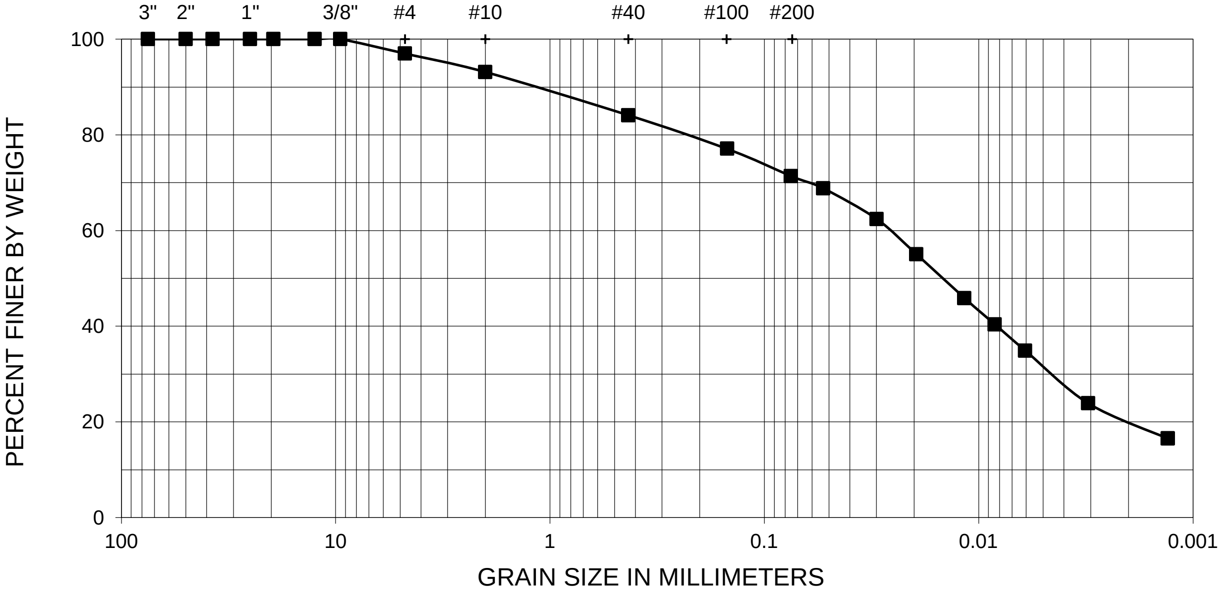
Initial Dry Mass Sample (gr): 165
Moisture Content Sample (%): 0

D_{60} = 2.88
D_{30} = 0.35
D_{10} = ---
$C_u = D_{60}/D_{10}$ = ---
$C_c = (D_{30})^2/(D_{10} * D_{60})$ = ---

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

PARTICLE SIZE ANALYSIS
WITH HYDROMETER
ASTM D422

PROJECT INFORMATION		SAMPLE INFORMATION		
Project:	Lake County Ohio Public Safety Center	***ASTM Description***	LEAN CLAY with sand	CL
Location:	0			
Project #:	093528.00	***OHIO Modified AASHTO***	Sandy silt	A-4a (7)
Test Date:	October 13, 2023			
Sample #:	0	***Sample Location***	B6 18.5'-20'	



SIEVE ANALYSIS

Sieve #	Sieve size, mm	Percent Passing
3"	75	100.0
2"	50	100.0
1-1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	97.0
#10	2	93.1
#40	0.43	84.1
#100	0.15	77.1
#200	0.074	71.4
#270	0.053	68.8

DISPERSION

Device	ASTM D422, Type A
Agent	Sodium Hexametaphosphate
Time in Agent	16 Hours

HYDROMETER ANALYSIS

Particle Size	Percent Passing
0.074 mm	71.4
0.053 mm	68.8
0.005 mm	31.6
0.0013 mm	16.5

ATTERBERG LIMITS

LIQUID LIMIT	28
PLASTIC LIMIT	19
PLASTICITY INDEX	9

PARTICLE DISTRIBUTION

D_{10}	NA	mm
D_{30}	0.004	mm
D_{50}	0.015	mm
D_{60}	0.026	mm
C_c	NA	
C_u	NA	

SAND AND GRAVEL DESCRIPTION

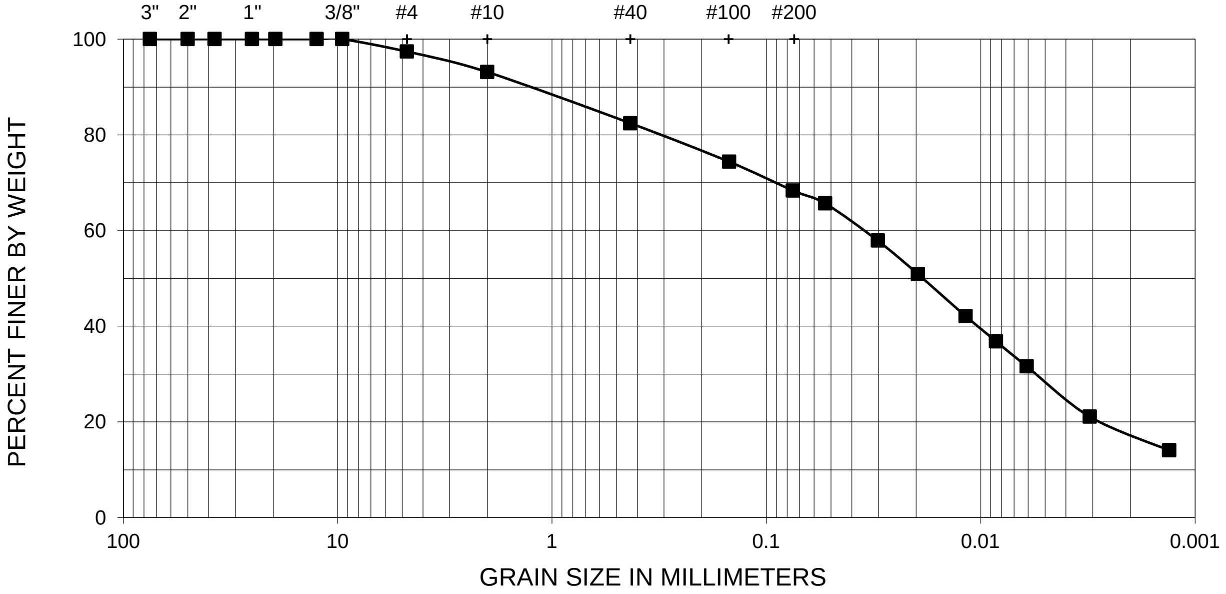
SHAPE	Angular
HARDNESS	Hard and durable

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

PARTICLE SIZE ANALYSIS WITH HYDROMETER ASTM D422

PROJECT INFORMATION	
Project:	Lake County Ohio Public Safety Center
Location:	0
Project #:	093528.00
Test Date:	October 13, 2023
Sample #:	0

SAMPLE INFORMATION		
ASTM Description	Sandy LEAN CLAY	CL
OHIO Modified AASHTO	Silt and clay	A-6a (8)
Sample Location	B15 13.5'-15'	



SIEVE ANALYSIS

Sieve #	Sieve size, mm	Percent Passing
3"	75	100.0
2"	50	100.0
1-1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	97.4
#10	2	93.1
#40	0.43	82.4
#100	0.15	74.4
#200	0.074	68.3
#270	0.053	65.6

HYDROMETER ANALYSIS

Particle Size	Percent Passing
0.074 mm	68.3
0.053 mm	65.6
0.005 mm	28.4
0.0013 mm	14.0

ATTERBERG LIMITS

LIQUID LIMIT	36
PLASTIC LIMIT	23
PLASTICITY INDEX	13

PARTICLE DISTRIBUTION

D_{10}	NA	mm
D_{30}	0.005	mm
D_{50}	0.019	mm
D_{60}	0.035	mm
C_c	NA	
C_u	NA	

DISPERSION

Device	ASTM D422, Type A
Agent	Sodium Hexametaphosphate
Time in Agent	16 Hours

SAND AND GRAVEL DESCRIPTION

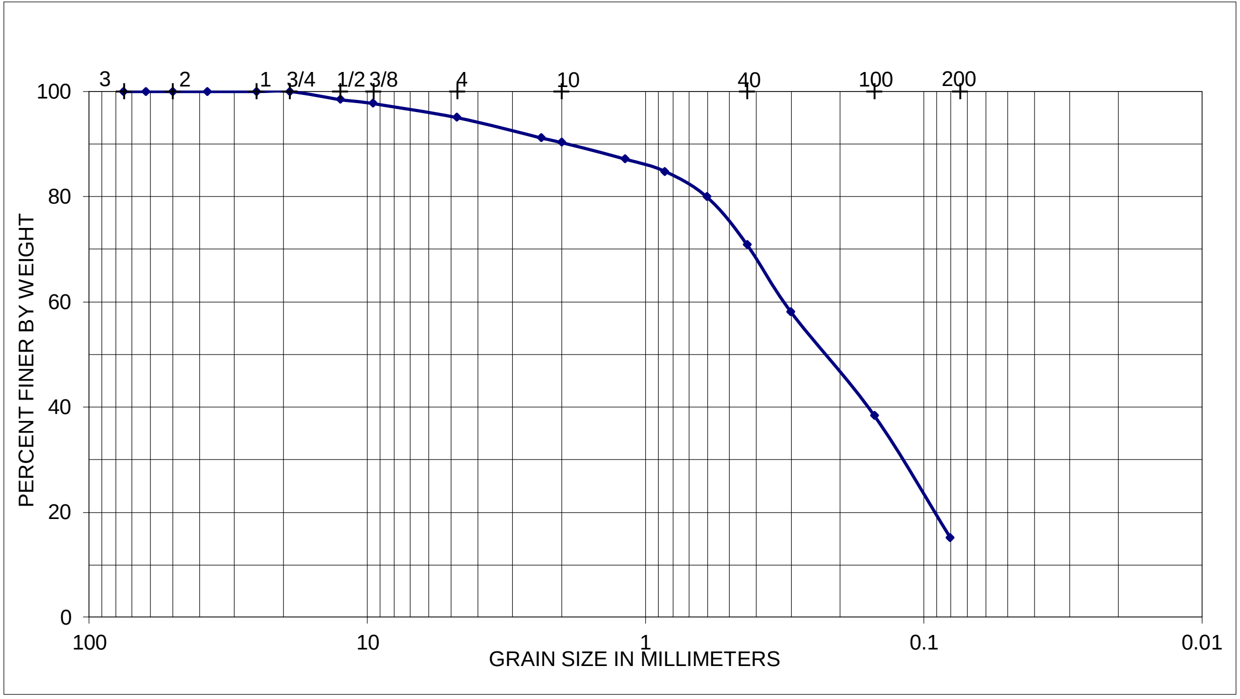
SHAPE	Angular
HARDNESS	Hard and durable

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Sieve Analysis
ASTM D422

Project: Lake County Ohio Public Safety Cent
Location: 0
Project #: 093528.00
Date: 10/10/2023

Sample Description: Silty clayey SAND
Sample Location: B-16; 3.5' - 5'
Sample #: SB2



Sieve #	Sieve size, mm	Total Percent Passing	Total Percent Retained	Individual Percent Retained
3	75	100	0	0
2-1/2"	62.5	100	0	0
2"	50	100	0	0
1-1/2"	37.5	100	0	0
1"	25	100	0	0
3/4"	19	100	0	0
1/2"	12.5	98	2	2
3/8"	9.5	98	2	1
#4	4.75	95	5	3
#8	2.36	91	9	4
#10	2	90	10	1
#16	1.18	87	13	3
#20	0.85	85	15	2
#30	0.6	80	20	5
#40	0.43	71	29	9
#50	0.3	58	42	13
#100	0.15	38	62	20
#200	0.08	15.1	84.9	23.2

Initial Dry Mass Sample (gr):	216
Moisture Content Sample (%):	0

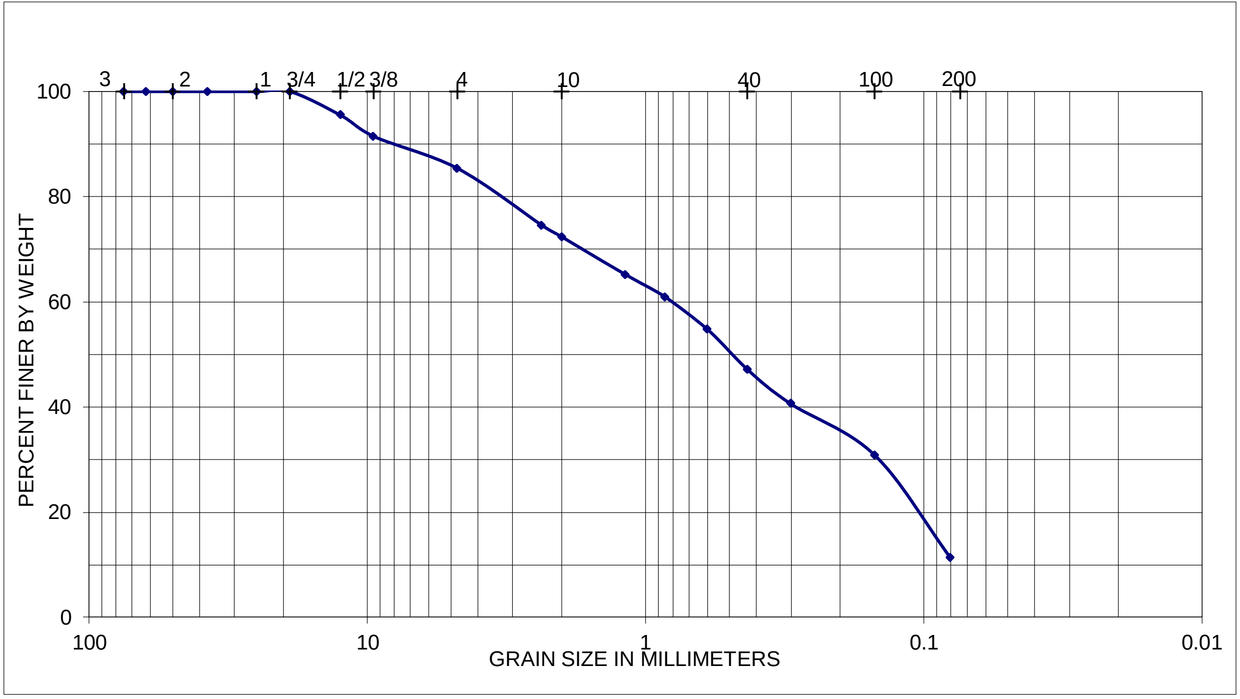
D_{60} =	0.32
D_{30} =	0.19
D_{10} =	---
$C_u = D_{60}/D_{10}$ =	---
$C_c = (D_{30})^2/(D_{10} * D_{60})$ =	---

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Sieve Analysis
ASTM D422

Project: Lake County Ohio Public Safety Cent
Location: 0
Project #: 093528.00
Date: 10/10/2023

Sample Description: Poorly graded SAND with silt/clay and gravel
Sample Location: B-22; 3.5' - 5'
Sample #: SB2



Sieve #	Sieve size, mm	Total Percent Passing	Total Percent Retained	Individual Percent Retained
3	75	100	0	0
2-1/2"	62.5	100	0	0
2"	50	100	0	0
1-1/2"	37.5	100	0	0
1"	25	100	0	0
3/4"	19	100	0	0
1/2"	12.5	96	4	4
3/8"	9.5	91	9	4
#4	4.75	85	15	6
#8	2.36	75	25	11
#10	2	72	28	2
#16	1.18	65	35	7
#20	0.85	61	39	4
#30	0.6	55	45	6
#40	0.43	47	53	8
#50	0.3	41	59	7
#100	0.15	31	69	10
#200	0.08	11.3	88.7	19.5

Initial Dry Mass Sample (gr): 250
Moisture Content Sample (%): 0

$D_{60} =$ 0.79
$D_{30} =$ 0.15
$D_{10} =$ ---
$C_u = D_{60}/D_{10} =$ ---
$C_c = (D_{30})^2/(D_{10} * D_{60}) =$ ---

SME
9375 CHILLICOTHE ROAD, KIRTLAND, OH 44094
PHONE: 440-256-6500 FAX: 440-256-6507

Compressive Strength of Intact Rock Core Specimens
ASTM D7012

PROJECT	Lake County Public Safety
LOCATION	Painesville, OH
DATE	September 8, 2023
PROJECT #	093528.00
CLIENT	Lake County Public Safety

SAMPLE	**1**	**2**	**3**	**4**
				
SAMPLE LOCATION	B-7; 39'	B-7; 45'	B-7; 47'	
DATE TESTED	September 8, 2023	September 8, 2023	September 8, 2023	
SAMPLE DESCRIPTION	SHALE	SHALE	SHALE	
CAPPED LENGTH, in	4.99	4.94	4.97	
DIAMETER, in	1.97	1.98	1.95	
AREA, sq. in.	3.05	3.08	2.99	
WEIGHT, gr	621.00	648.00	653.00	
WET DENSITY, pcf	155.5	162.3	167.6	
LOAD AT FAILURE, lbs.	12,175	10,500	13,225	
GROSS UNIT STRESS, psi	3,994	3,410	4,428	
LENGTH/DIAMETER RATIO	2.5	2.5	2.5	
UNIT STRESS CORRECTED, psi	**3,990**	**3,410**	**4,430**	
MOISTURE CONDITION WHEN TESTED	MOIST	MOIST	MOIST	

REMARKS:

Samples tested do not meet the requirements for sample preparation per ASTM D4543

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POINT LOAD STRENGTH INDEX OF ROCK FOR NX CORES, ASTM D5731

Project Lake County Public Safety
Location 0
Project # 093528.00
Test Date 9/19/2023
Date obtained: 8/24/2023
Obtained by: RH
Sample Description Shale
Storage Environment: Moist room
Test Apparatus: Tecnotest Point Load Tester
Last calibration: 5/1/2023
Tested by: SM

Test #	Sample Location	Sample Depth	Test Type	Width (W), (mm)	Diameter (D), (mm)	Load (P), (N)	D_e^2, (mm^2)	D_e, (mm)	I_s, (MPa)	F	$I_{s(50)}$, (Mpa)	S_c (MPa)	S_c (psi)
1	B-3	34'	A	49.92	30.44	4175	1935	44.0	2.16	0.94	2.02	46.55	6750
2	B-3	36'	A	50.28	27.71	1485	1774	42.1	0.84	0.92	0.77	17.67	2560
3	B-3	38'	A	50.31	48.95	4640	3136	56.0	1.48	1.06	1.57	36.02	5220
4	B-3	40'	A	50.20	45.65	5385	2918	54.0	1.85	1.04	1.92	44.12	6400
5	B-3	43.5'	A	49.83	37.69	1645	2391	48.9	0.69	0.99	0.68	15.65	2270
6													
7													
8													
9													
10													

REMARKS:
Test Type: d = diametral test, a = axial test

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

GENERAL COMMENTS

LABORATORY TESTING PROCEDURES

Important Information about This

Geotechnical-Engineering Report

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

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

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
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GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner’s budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110° C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440° C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a 1/2-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool 1/2 inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content, and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.

GRAIN SIZE DISTRIBUTION ANALYSIS

COARSE-GRAINED (GRANULAR) SAMPLES WITH LOW FINES CONTENT

Grain size distribution tests performed on granular samples involves oven-drying a representative sample of soil and washing out the fines (passing the No. 200 sieve) with tap water. The sample retained on the No. 200 sieve is then oven-dried, cooled and sieved on a series of stacked sieves beginning with the largest sieve on top and progressing to the smallest on the bottom. The portions of the sample retained on each sieve are then weighed and used to develop the grain size distribution curve in the report for each sample tested.

FINE-GRAINED (SILT OR CLAY) SAMPLES OR COARSE-GRAINED SAMPLES WITH HIGH FINES CONTENT

Particle size distribution tests performed on fine-grained or coarse-grained samples with a high fines content involves oven-drying a representative sample and mixing the sample with a liquid deflocculant to disperse the soil particles. The slurry is placed in a graduated cylinder and shaken to suspend the soil particles in the slurry. The graduated cylinder is then placed on a tabletop; a calibrated hydrometer is floated in the slurry to determine its density. The hydrometer measurements are made at selected time intervals as the soil in the cylinder settles and slurry density decreases. When the hydrometer measurements are completed, the slurry is poured onto a No. 200 sieve and the fines are washed out with tap water. The sample retained on the No. 200 sieve is then oven-dried, cooled and sieved on a series of stacked sieves beginning with the largest sieve on top and progressing to the smallest on the bottom. The portions of the sample retained on each sieve are then weighed and used with the hydrometer data to develop the grain size distribution curve in the report for each sample tested.

WET/DRY DENSITY TESTS

Wet/dry density tests involve extracting a representative soil sample from either a Shelby tube or sample liner, trimming the ends perpendicular to the length of the sample and measuring the length and diameter. The sample is then weighed, oven-dried and weighed again after drying. The wet density is equal to the wet weight of the sample (prior to drying) divided by the volume, while the dry density is the dry weight of the sample divided by the volume.

UNCONFINED COMPRESSIVE STRENGTH TESTS

In addition to the hand penetrometer and Torvane tests, unconfined compression tests were performed to better estimate the undrained shear strength of selected cohesive samples recovered from either Shelby tubes or liners taken in conjunction with the Standard Penetration Test. In the unconfined compression test, the unconfined compressive strength of a soil sample is determined by axially loading the soil sample at a slow, constant rate of strain. The unconfined compressive strength is the maximum compressive stress in the soil sample, up to 15 percent strain. Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength presented on the boring logs is reported in units of kips per square-foot (ksf).

CORROSION TESTS

The soil corrosion tests may include measuring the electrical resistivity, pH and concentrations of soluble chlorides and sulfates. Soil samples tested are generally taken from a composite of two or more selected soil samples with generally similar visual characteristics. The electrical resistivity of the selected soil samples was performed on natural-state and saturated samples using a Miller multi-combination meter with a soil box configured in a four-pin arrangement. pH tests are typically conducted using litmus test paper. The soil samples for the soluble sulfates and chlorides were prepared as a water-soil solution, typically at a water-to-soil ratio of 20:1, and tested in general accordance with local laboratory methods for measuring sulfate and chloride concentrations.

MOISTURE-DRY DENSITY RELATIONSHIPS (COMPACTION) TESTS

Moisture-dry density tests involve the preparation of a bulk soil sample by compacting the sample at a given energy into a calibrated mold with a known volume of 0.0333 cubic feet at various moisture contents. A graph of the moisture content vs. dry density is developed, which results in an inverted U-shaped curve. The maximum dry density is the peak of the curve and the corresponding moisture content is the optimum moisture. Two methods can be performed, namely:

STANDARD PROCTOR METHOD

This method involves a standard energy of 12,400 ft-lbs per cubic foot of soil volume to compact the sample. The sample is compacted in three layers of equal thickness using a 5.5-pound hammer dropped 12 inches using 25 blows per layer.

MODIFIED PROCTOR METHOD

This method involves a modified energy of 56,000 ft-lbs per cubic foot of soil volume to compact the sample. The sample is compacted in five layers of equal thickness using a 10-pound hammer dropped 18 inches using 25 blows per layer.

SPECIFIC GRAVITY TESTS

This test involves the determination of the ratio of the weight of a known volume of soil particles in air to weight of the same volume of water in air. The test is performed by oven drying a soil sample and placing the sample with water into a calibrated pycnometer, boiling the soil/water mixture, filling the pycnometer with distilled water to its calibration mark, weighing the pycnometer and soil/water mixture and measuring the temperature of the mixture. The specific gravity is equal to the weight of the dry soil particles multiplied by the specific gravity of distilled water at the temperature measured for the soil/water mixture divided by the sum of the weight of the dry soil particles plus the weight of the pycnometer, soil/water mixture plus the weight of the pycnometer plus water from the calibration curve developed for the pycnometer.

DIRECT SHEAR TESTS

A bulk sample is compacted in a direct shear mold at a specified density and moisture content. Shear tests are then performed using the direct shear procedure. The direct shear test is performed at several overburden pressures or normal stresses that represent approximate potential stresses in the proposed construction. Values of both peak friction angle and residual friction angle are determined from the tests for each overburden pressure. The results of the direct shear tests are tabulated and plotted on the Direct Shear Test Plots in Appendix A.

CONSOLIDATION TESTS

Consolidation tests are used to evaluate the magnitude and rate of consolidation of soil when it is restrained laterally and drained on the top and bottom while subjected to vertical load applied in controlled increments. The range of test loads applied is generally selected to represent the anticipated vertical stress conditions resulting from existing conditions and the proposed construction. Plots of the percent strain vs. log pressure are constructed from the data to assess consolidation characteristics, while the rate of consolidation is evaluated from plots of deformation vs. time for each vertical load increment.

PERMEABILITY TESTS

The permeability of either relatively undisturbed or compacted soils can be determined by various laboratory test equipment including a triaxial cell, permeameter mold or from a liner sample. The type of permeability equipment used and test performed will be based on the soil type being evaluated.

CLAY, SILT AND OTHER LOW PERMEABLE SOIL SAMPLES

For samples with relatively low permeability characteristics, an undisturbed or compacted soil sample is placed in a triaxial cell. Prior to performing the permeability test, the sample must be fully saturated by forcing water into the sample using a backpressure (water under pressure from an air supply) which is slightly less than the cell pressure. Once the sample is saturated, water is forced through the top of the sample with pressure from an air supply (which is slightly less than the cell pressure) and water forced out of the bottom of the sample is measured in a burette. The volume of water displaced from the sample is recorded with time and from that information, the coefficient of permeability is calculated. This method is a constant head permeability test.

SAND SAMPLES

Due to the nature of relatively clean granular soils, the use of a triaxial cell is generally not practical and the permeability of these types of soils is typically determined from either a liner sample (either recovered directly from a split-spoon in the field or a sample compacted in the liner) or a bulk sample compacted in a 6-inch diameter permeameter mold. A falling head permeability test can be performed on most granular samples by filling a standpipe with water and measuring the head drop with time. For highly permeable soils, the rate of drop in a falling head test may be too rapid to obtain reliable volume and time measurements. Thus, a constant head test will be required where a constant head of water is maintained, and the volume of water discharged from the sample is measured with time.

TRIAXIAL TESTS

Triaxial tests were conducted on samples trimmed from Shelby tubes or liners. There are several types of triaxial tests which can be performed, and each are described below:

UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST METHOD

The strength and stress-strain relationships of a cylindrical soil sample are determined for a sample subjected to a selected confining fluid pressure in a triaxial chamber. No drainage of the sample is permitted during the test and the sample is sheared in compression at a constant rate of axial deformation. The peak stress measured for the sample is recorded, up to a maximum 15 percent strain. At least three triaxial tests are performed at various confining fluid pressures to model in-situ stress conditions for loading. A plot of the Mohr circles at failure stress for each confining pressure is included in Appendix A.

CONSOLIDATED-DRAINED TRIAXIAL TEST METHOD

The strength and stress-strain relationships of a cylindrical soil sample are determined for a sample subjected to a selected confining fluid pressure in a triaxial chamber. The sample is isotropically consolidated prior to applying axial loads and sheared in compression at a slow constant rate of axial deformation while allowing the sample to drain. The peak stress measured for the sample is recorded, up to a maximum 15 percent strain. At least three triaxial tests are performed at various confining fluid pressures to model in-situ stress conditions for loading. A plot of the Mohr circles at failure stress for each confining pressure is included in Appendix A.

CONSOLIDATED-UNDRAINED TRIAXIAL TEST METHOD

The strength and stress-strain relationships of a cylindrical soil sample are determined for a sample subjected to a selected confining fluid pressure in a triaxial chamber. The sample is isotropically consolidated prior to applying axial loads and sheared undrained in compression at a constant rate of axial deformation. Pore water pressure measurements can also be measured during the shearing of the sample. The peak stress measured for the sample is recorded, up to a maximum 15 percent strain. At least three triaxial tests are performed at various confining fluid pressures to model in-situ stress conditions for loading. A plot of the Mohr circles at failure stress for each confining pressure is included in Appendix A.

DENSITY TESTS ON ROCK CORES

Density tests involve trimming the ends of an intact rock core sample perpendicular to the length of the sample and measuring the length and diameter. The sample is then weighed, and the weight is divided by the volume to calculate the density.

UNCONFINED COMPRESSIVE STRENGTH TESTS ON ROCK CORES

Unconfined compression tests were performed to estimate the compressive strength of selected rock core samples. Representative rock cores were selected and cut perpendicular to the length of the sample on both ends to a specified length with a wet saw. In the unconfined compression test, the unconfined compressive strength of a rock core sample is determined by axially loading the rock core sample at a slow, constant rate of strain. The unconfined compressive strength is the maximum compressive stress in the rock core sample, or the load applied when a predetermined amount of strain is achieved.

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