STRUCTURE FOUNDATION EXPLORATION

Proposed Mast Arm Signal Support

Indiana Avenue

Auglaize County, Ohio

AUG-SMA-2204-INDIANA WALKS

BMI Report No. 215746-0924-171r1

Submitted to:
Choice One Engineering
September 13, 2024
Revised December 2, 2024

Prepared by:

BOWSER MORNER

4518 Taylorsville Road, Dayton, Ohio 45424

OHIO DEPARTMENT OF TRANSPORTATION

December 2, 2024

Choice One Engineering
Attention: Mr. Brad Walterbusch, P.E.
440 E. Hoewisher Road
Sidney, Ohio 45365

Re: **STRUCTURE FOUNDATION EXPLORATION**
AUG-SMA-2204-INDIANA WALKS
Proposed Mast Arm Signal Support, Indiana Avenue, St. Marys, Ohio
Report No. 215746-0924-171r1

Ladies and Gentlemen:

The attached report summarizes Bowser-Morner, Inc.'s activities, findings, conclusions and recommendations for the proposed Mast Arm Signal Support along Indiana Avenue in St. Marys, Ohio.

The purpose of this exploration was to evaluate the subsurface conditions beneath the proposed structures in accordance with the Ohio Department of Transportation's "Specifications for Geotechnical Explorations", dated July 2023. The attached report reviews our exploration procedures, describes existing site and subsurface conditions, and presents our evaluations, conclusions, and recommendations. For your convenience, we will hold all samples recovered from the site at this laboratory for a period of 60 days unless we are otherwise advised.

It has been our privilege to work with you and your staff on this project and we are prepared to assist you at any time. Please contact us if you have questions about this report or if we may be of further service.

Respectfully submitted,

BOWSER-MORNER, INC.

Daniel M. Otieno
Geotechnical Engineer

Chris R. Ryan, M.S.C.E., P.E.
Sr. Geotechnical Engineer

STATE OF OHIO
CHRISTOPHER R. RYAN
E-76764
REGISTERED
PROFESSIONAL ENGINEER

Christopher R. Ryan

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Reason: I am the author of this document
Location:
Date: 2024.12.02 14:26:23-05'00'
Foxit PDF Editor Version: 12.0.2

DO/CRR/an

GUIDELINES FOR THE USE OF THIS REPORT & MANDATORY INFORMATION

This BMI geotechnical report has been prepared for the exclusive use of Choice One Engineering for use in connection with the planned Mast Arm Signal Support along Indiana Avenue in St. Marys, Ohio. The data, findings, conclusions and recommendations contained within this report are intended to:

- Aid the client in evaluating the feasibility of developing this site for the intended project,
- Provide the design engineer information which may be used to select and proportion appropriate foundations for this project.
- To provide general recommendations regarding earthwork, grading and soil improvement for consideration by the designers to assist in the preparation of construction documents.

This report is <u>not</u> a construction document. Although there is information within this report that may assist experienced contractors and engineers in identifying risks and construction issues that may develop over the course of this project, our scope of services did not include a detailed review of potential constructability concerns.

Because this report was very likely prepared before structure orientations, grades, loads and other features have been finalized, it is strongly recommended that Bowser-Morner be retained to review final design documents prior to the start of construction when potential weather impacts and design requirements can be fully understood and addressed.

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1.0 EXECUTIVE SUMMARY

This section summarizes the subsurface and laboratory exploration data and geotechnical engineering analyses for the proposed Mast Arm Signal Support along Indiana Avenue in St. Marys, Ohio.

1.1 Soil Profile

The ground surface elevation at the time of the exploration was approximately 890.1 feet in Boring B-001. Topsoil was encountered in this boring. Below the topsoil, silt and clay was encountered and extended to the bottom of this boring at a depth of 35 feet.

1.2 Groundwater Observations

Groundwater was not encountered during the boring operations.

1.3 Foundations

The Mast Arm Signal Support may be supported on a spread footing bearing directly on the subgrade soil. The bottoms of exterior footing foundations should be placed at least 36 to 42 inches below the final adjacent grades to protect against frost penetration and heaving. Foundations may be designed with a nominal bearing capacity of 4,000 pounds per square foot (psf).

Alternatively, single poles, auger-cast piles or drilled shafts can be installed through the weak soil layers and supported on more firm soil to support the mast arm signal foundation. Based on the "N" values indicated in the borings made for this study, the tips of the single poles should extend to a depth of at least 18.5 feet below the existing grade.

For the poles or shafts extending to a depth of 18.5 feet, the pole foundations can be designed with an allowable end-bearing capacity of 6,000 psf. For the poles installed in the overburden soil layer below the topsoil layer, the part of the poles in contact with the original soil can also be assigned with an average side friction capacity of 200 psf. For the parts of poles, drilled shafts or the auger-cast piles in contact with the subgrade soil below a depth of 18.5 feet, the poles, shafts or piles can be designed with an allowable side friction of 300 psf.

To determine the actual allowable capacity of the deep foundations against the vertical loading, we recommend that static load tests be performed to verify the allowable pole capacity.

2.0 INTRODUCTION

Project Description – A Mast Arm Signal Support will be installed along Indiana Avenue in St. Marys, Ohio. The proposed mast arm signal will be located at the southeast corner of the intersection of Indiana Avenue and Executive Drive.

Exploration Scope - The purpose of this subsurface exploration and geotechnical engineering evaluation was to determine the subsurface conditions at the project site and to analyze these conditions as they relate to foundation design and construction. All work was performed in accordance with Bowser-Morner, Inc. (BMI) proposal No. 24-2771-035 dated April 11, 2024. Authorization to proceed with this soil study was given by Choice One Engineering in a signed proposal acceptance sheet dated July 9, 2024. The scope of the exploration included subsurface drilling and sampling, limited laboratory testing, engineering evaluation of the field and laboratory data, and the preparation of this report.

3.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

3.1 General Geology and Hydrology

The project site is situated in Auglaize County which consists of Wisconsin Age glacial deposits which include glacial till, lacustrine deposits, alluvial (river) deposits, and ice-contact sand and gravel (kames, eskers) deposits. During the Pleistocene Epoch, the Wisconsinan Glaciation (which occurred between 14,000 to 24,000 years ago) had a profound impact on the topography, soil, and hydrology of the county. Glacial features formed in the county from deposition as the glaciers melted include moraines, till plains, and outwash plains.

The surface soils in the vicinity of the site is characterized as disturbed or urban land. It is underlain by clayey Wisconsin till, an unsorted, non-stratified mix of sand, grave, silt and clay. Clayey Wisconsin till has a fine texture, low permeability and tends to retain water due to the dominance of clay in the mixture. It is prone to waterlogging and can become quite sticky when wet. It is often gray-to-brown in color. The disturbed or urban land is shaded light green in the diagram below whereas the clayey Wisconsin till is shaded brown.

The bedrock in Auglaize County includes limestone and dolomite from the Silurian age.

(References: "Groundwater Pollution Potential of Auglaize County, Ohio", Michael P. Angle and Kelly Barrett, Ohio Dept. of Natural Resources, 2005; Soil Explorer. Online at http://SoilExplorer.net. Accessed 09/12/2024.)

The diagram below illustrates the primary geologic surface layers of the property as mapped by the US Department of Agriculture. It indicates that the variations of the disturbed/urban land in the boring include (a) a unit characterized as Ud (Udorthents loamy, rolling), (b) a unit characterized as BdUXB (Blount-Urban land complex, 2 to 4 percent slopes), and (c) a unit characterized as UbBXB (Urban land-Blount complex, 2 to 4 percent slopes). Udorthents are soils with significant evidence of disturbance, often due to human activity or natural processes like erosion. In the vicinity of this site, it appears that the surface soil is disturbed, but has a balanced composition of sand, silt and clay. Blount soils are typically found in hilly or rolling landscapes and are often loamy or clayey.

3.2 Field and Office Reconnaissance

ODOT TIMS - Prior to the field exploration, BMI's geotechnical engineering staff conducted a review of the ODOT Transportation Information Mapping System (TIMS) to determine whether previous soil boring data was available to assist in the evaluation of this project. Two soil borings were located adjacent to this intersection. One boring was located to the northwest at Sta. 166+00 and the other boring was located to the southeast at Sta. 171+00. Both of these borings extended to a depth of ten feet and consisted of silty clay subgrade soils.

ODNR - BMI also conducted a review of geologic data available from the Ohio Department of Natural Resources (ODNR) divisions of Geological Survey, Mineral Resource Management, and Soil and Water. This data, which included bedrock geology, topography and water well records were used to ascertain general soil conditions and bedrock depths across the project study area. Additionally, BMI searched the ODNR database of abandoned mine land sites to ascertain whether there was any documented mine activity in the project area.

Field Reconnaissance – A field reconnaissance was performed on July 11, 2024.

Other Sources - Additionally, we performed a desk reconnaissance of the site by reviewing current and historic online aerial photography published on Google Earth.

4.0 EXPLORATION

4.1 Field Exploration

Exploration Scope – One soil test boring (numbered B-001) was drilled on July 16, 2024 at the following location:

- B-001 – Station 169+35, 45' RT   Surface Elevation 890.1

The stations and elevations listed above were provided by others and should be considered approximate. The approximate boring locations are illustrated on the attached *Boring Location Plan* in Appendix A. The boring was advanced to a depth of 35 feet.

Boring Layout & Staking: Boring locations were established in the field by Choice One Engineering and Bowser-Morner, Inc.

Soil Sampling Procedures – Soil sampling and standard penetration testing was conducted in general accordance with ASTM D 1586 (AASHTO T206). Borings were advanced by an ATV-mounted drilling rig by mechanically twisting hollow-stem augers into the soil. At regular intervals, soil samples were obtained with a standard 2-inch O. D. split spoon sampler driven 18 inches into the soil with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and designated the "standard penetration resistance." The standard penetration resistance, or "N" value, when properly evaluated, is an index of the soil's strength, density, and ability to support foundations. The disturbed samples recovered by the split spoon sampler were visually classified in the field, logged, sealed in glass jars, and returned to the laboratory for testing and evaluation by a geotechnical engineer.

Boring logs indicating soil descriptions, penetration resistances, and observed groundwater levels are included in Appendix B.

Borehole Sealing/Backfilling – Borings were backfilled with soil cuttings mixed with bentonite chips at the completion of drilling.

Drill Rig Calibration – The drill rig hammer was calibrated prior to the field exploration on June 18, 2024, by CTL Engineering, Inc. in accordance with ASTM D4633, Standard Test Methods for Energy Measurement for Dynamic Penetrometers. The automatic hammer mounted on the Diedrich D-50 drill rig used for these borings had a hammer efficiency of 81.3 percent.

4.2 Laboratory Testing

Laboratory testing performed during this study included:

Soil Classification Testing

- In the laboratory, the samples recovered from the borings were each examined and visually classified by BMI geotechnical engineers according to the ODOT Soil Classification Method, which is in general agreement with AASHTO M145 "Classification of Soil Aggregate Mixtures for Highway Construction Purposes."

- Three (3) ODOT Soil Classifications (including washed sieve, hydrometer, and Atterberg limits analyses) were performed on representative samples from the borings in general accordance with ASTM D422 and D318. Test results are presented on the boring logs.
- Natural moisture content determinations were performed on all split spoon samples recovered from the soil test borings in accordance with ASTM D2216 (AASHTO T265). The results of the moisture content determination tests are presented on the boring logs.

5.0 FINDINGS

5.1 Soil Profile

Data from the soil test borings are shown on the attached *Boring Logs*. The subsurface conditions discussed in the following paragraphs and those shown on the boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

The ground surface elevation at the time of the exploration was approximately 890.1 feet in Boring B-001. Based on the information from the single boring made for this study, the subgrade soil conditions are described in descending order below:

STRATUM 1: TOPSOIL: Encountered from Surface to depth of ±12 inches.

Approximately twelve inches of topsoil.

STRATUM 2: GLACIAL DRIFT: Encountered below stratum 1 to bottom of boring at 35 feet.

Stiff-to-hard, brown-to-dark brown or gray silt and clay with traces of gravel, cobbles, and little sand throughout the stratum. The layer extends to the bottom of the boring at a depth of 35 feet below the existing grade.

5.2 Groundwater Observations

During the field exploration, the drilling rods and sampling equipment were continuously checked by the drillers for indications of groundwater or seepage. No groundwater was encountered during the boring operations.

Groundwater levels fluctuate with seasonal and climatic variations and may be different at other times. More specific information regarding groundwater levels, standard penetration resistances, and soil descriptions is detailed on the boring logs in Appendix B.

6.0 ANALYSES AND RECOMMENDATIONS

The following evaluations and conclusions are based on our interpretation of the field and laboratory data obtained during the exploration and our experience with similar subsurface conditions. Soil penetration data and laboratory data have been used to estimate allowable bearing pressures using commonly accepted geotechnical engineering practices. Subsurface conditions in uninvestigated locations between borings may vary considerably from those encountered in the borings. If structure location, loadings, or levels are changed, we request we be advised so we may re-evaluate our recommendations.

6.1 Foundations

The proposed construction is to consist of a new Mast Arm Signal Support along Indiana Avenue in St. Marys, Ohio. Design loads were not provided.

Boring B-001 was performed at the southeast corner of the intersection of Indiana Avenue and Executive Drive. Based on information from this boring, the area is covered with topsoil over silt and clay.

The bottoms of the foundations should be placed at least 36 to 42 inches below the final grade to protect against frost penetration and potential heaving.

Based on the results of the standard penetration tests (SPT) in Boring B-001, the "N60" value at a depth of 3.5 feet below grade is 31 blows per foot. The nominal bearing resistances by the "LRFD" design method is tabulated in Table 6-1. The soil-bearing analysis sheet is included in the appendix of this report.

Table 6-1. Nominal Bearing Resistance with Depth and Elevation

Boring No.	Depth to Bearing Strata (ft)	Elevation at Top of Bearing Strata (ft)	Nominal Bearing Resistance (psf)
B-001	3.5	886.6	4,000

After the excavation extends to the desired grade, the top foot at the bottom of the excavation should be compacted in accordance with ODOT specifications before any new fill or foundation is placed. Any soft soil pockets should be undercut and replaced with compacted fill.

After the bottom of the excavations have been compacted, structural fill can be placed to bring the bottom of the excavation to the desired grade if needed. The fill placed below the bottoms of the foundations should be placed and compacted in accordance with ODOT specifications. The design of the foundations are beyond the scope of this study.

Alternatively, single poles, auger-cast piles or drilled shafts can be installed through the weak soil layers and supported on more firm soil to support the mast arm signal foundation. Based on the "N" values indicated in the borings made for this study, the tips of the single poles should extend to a depth of at least 18.5 feet below the existing grade.

For the poles extending to a depth of 18.5 feet, the pole foundations can be designed with an allowable end-bearing capacity of 6,000 psf. For the poles installed in the overburden soil layer below the topsoil layer, the part of the poles in contact with the original soil can also be assigned with an average side friction capacity of 200 psf. For the parts of poles, drilled shafts or the auger-cast piles in contact with the subgrade soil below a depth of 18.5 feet, the poles, shafts or piles can be designed with an allowable side friction of 300 psf.

To determine the actual allowable capacity of the deep foundations against the vertical loading, we recommend that static load tests be performed to verify the allowable pole capacity.

Since the design of the lighting pole foundations should consider the over-turning moment applied by the lighting fixtures on the poles or by the wind loads, the foundations may be supported on poles that extend to the suitable bearing stratum. For the design of the foundations with poles embedded in soil borings performed for this study, the unit soil weight of 120 pounds per cubic foot (pcf) for the moist soil can be considered. The design computation of the lateral earth pressure will be based on the wet unit weight of soil at 120 pcf and the passive soil pressure coefficient “kp” of 2 in clay layer. The total passive lateral earth resistance force, Pp, can be computed using the following equation:

$$Pallowable = \frac{(120)H\hat{}2kp}{2*3}$$

The computed $P_{allowable}$ will have a safety factor of 3 included in the above equation. “H” is the total embedded length of any drilled shaft, auger-cast piles, or poles. The total force will be acting at a depth of 2/3 H measured from the top of the ground surface.

If the site will be flooded or the subgrade soil will be fully saturated, the buoyed weight of soil will be 60 pounds per cubic foot (pcf). The total resistance force, Pp, can be computed using the following equation:

$$P_{allowable} = \frac{(60)H^2 k_p}{2*3}$$

The computed $P_{allowable}$ will have a safety factor of 3 included in the above equation. “H” is the total embedded length of the pole. Again, the total force will be acting at a depth of 2/3 H measured from the top of the ground surface. However, we understand that the site is protected by the FEMA levee system and that the site has not experienced any flooding in the past.

6.2 Drainage

Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation soils during and after construction. The exterior grade including all pavements or parking areas should be sloped away from the new foundation to keep water from ponding.

6.3 Groundwater Control

Groundwater was not encountered during the boring operations. We do not expect significant difficulties with groundwater during construction. However, groundwater and surface runoff will tend to accumulate in open excavations. We anticipate that the amount of water that does accumulate, if any, will be light and can be removed by pumping from prepared sumps as needed.

If groundwater is encountered during the installation of the drilled shafts, temporary steel casings should be used during the installation of the drilled shafts. The steel casings will seal off the groundwater flow and keep the sides of the shafts from caving in. After the concrete is placed, the steel casings can be removed and reused. While groundwater should not be a problem for the installation of drilled shafts, a tremie method of installing the drilled shafts would be required if the groundwater cannot be lowered by pumping.

The amount and type of dewatering required during construction will depend on the weather and groundwater levels at the time of construction and the effectiveness of the contractor's techniques in preventing surface runoff from entering open excavations. Typically, groundwater levels are highest during winter and spring months and lower in summer and early fall.

6.4 Slopes and Temporary Excavations

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences, and operations of construction operations. BMI is providing the following information solely as a service to the client. Under no circumstances should BMI's provision of the following information be construed to mean BMI is` assuming responsibility for construction site safety or the contractor's activities; such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations; e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties.

The soils encountered in our exploration consisted primarily of silts and clays. We anticipate OSHA will classify the natural soil materials as Type B.

Note: Soils encountered in construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in widely-spaced borings. The contractor should verify similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, BMI recommends we be contacted immediately to evaluate the conditions encountered.

If any excavation, including a utility trench, is extended to a depth of more than 20 feet, OSHA requires the side slopes of such excavation be designed by a professional engineer.

7.0 QUALIFICATIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project, and our experience with similar sites and subsurface conditions. Data used during this exploration included, but was not necessarily limited to:

- one (1) exploratory borings performed during this study;
- observations of the project site by our staff;
- results of (limited) laboratory soil testing;
- site plans and drawings furnished by Choice One Engineering; and
- published soil or geologic data of this area.

In the event changes in the project characteristics are planned, or if additional information or differences from the conditions anticipated in this report become apparent, BMI should be notified so the conclusions and recommendations contained in this report can be reviewed and, if necessary, modified or verified in writing.

The subsurface conditions discussed in this report and those shown on the boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Laboratory test results contained in this report are reflective only of the items calibrated or tested. Unless otherwise agreed, samples or specimens will be discarded or returned at BMI's discretion.

Regardless of the thoroughness of a subsurface exploration, there is the possibility conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by designers, or that the construction process has altered the soil conditions. As variations in the soil profile are encountered, additional subsurface sampling and testing may be necessary to provide data required to re-evaluate the recommendations of this report. Consequently, after submission of this report, it is recommended BMI be authorized to perform additional services to work with the designer(s) to minimize errors and/or omissions regarding the interpretation and implementation of this report.

Prior to construction, we recommend that BMI:

- work with the designers to implement the recommended geotechnical design parameters into plans and specifications;
- consult with the design team regarding interpretation of this report;
- establish criteria for the construction observation and testing for the soil conditions encountered at this site; and
- review final plans and specifications pertaining to geotechnical aspects of design.

During construction, we recommend that BMI:

- observe aspects of the construction requiring geotechnical interpretation or additional analysis;
- perform additional subsurface borings and/or laboratory testing as required; and
- consult with the design team to make design changes in the event differing subsurface conditions are encountered.

If BMI is not retained for these services, we shall assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, expressed or implied, is made.

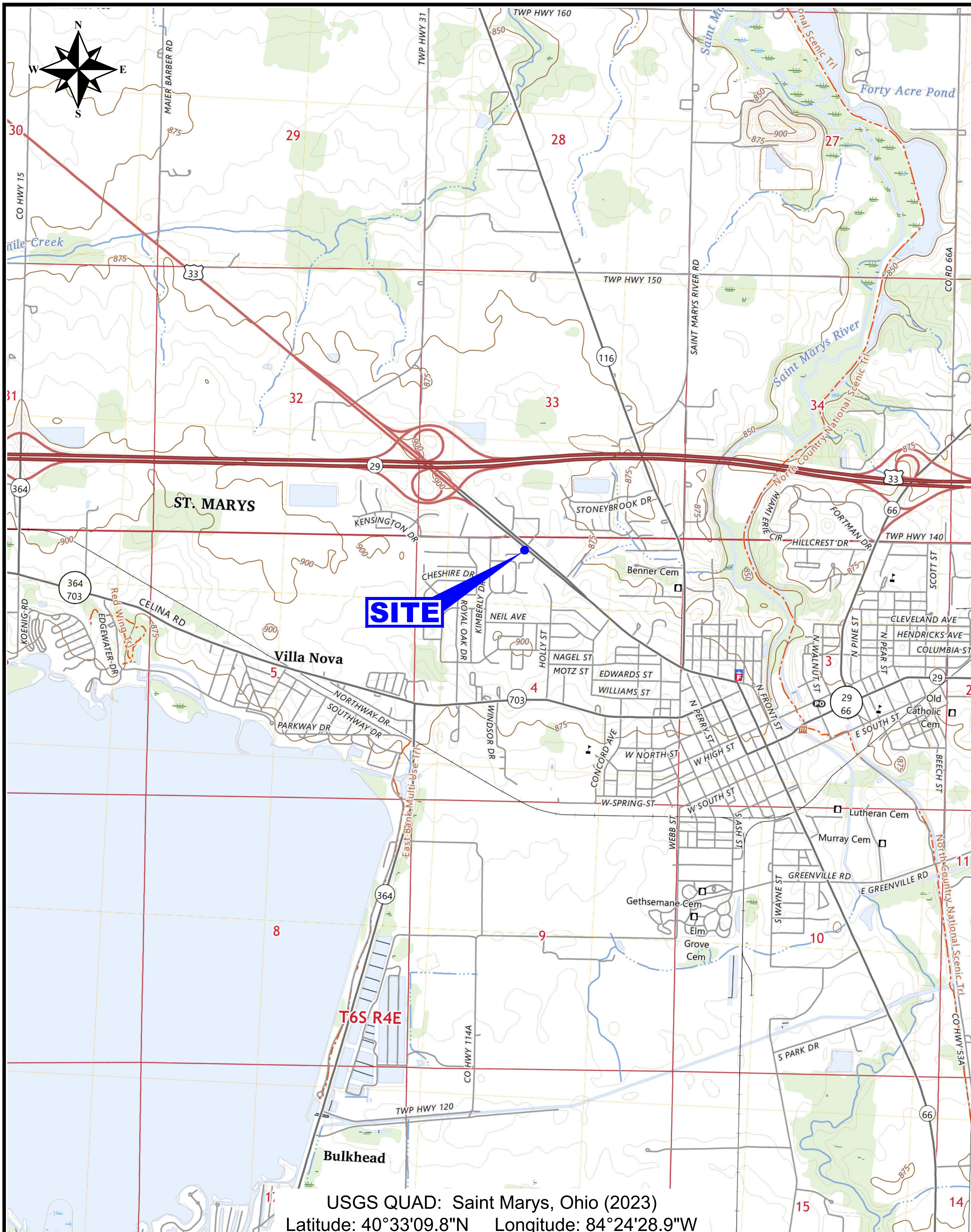
The scope of our services did not include an environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on, within, or beyond the site studied. Our work also did not include anything related to mold. Our scope of services also did not include an evaluation for the presence or absence of wetlands or protected species. Any statements in the report or on the boring logs regarding odors, staining of soils, or other unusual items or conditions observed are strictly for the information of our client.

This report has been prepared for specific application to the Mast Arm Signal Support along Indiana Avenue in St. Marys, Ohio. All reports remain the confidential property of BMI. By agreement, this report has been distributed to our client, Choice One Engineering. No additional publication or distribution of this report may be made without our express written consent, except as authorized by contract.

Specific design and construction recommendations have been provided in the various sections of the report. The report should, therefore, be used in its entirety. This report is not a bidding document and shall not be used for that purpose. Anyone reviewing this report must interpret and draw their own conclusions regarding specific construction techniques and methods chosen. BMI is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report.

APPENDIX A:

BORING LOCATION PLAN



USGS QUAD: Saint Marys, Ohio (2023)

Latitude: 40°33'09.8"N Longitude: 84°24'28.9"W

VICINITY MAP

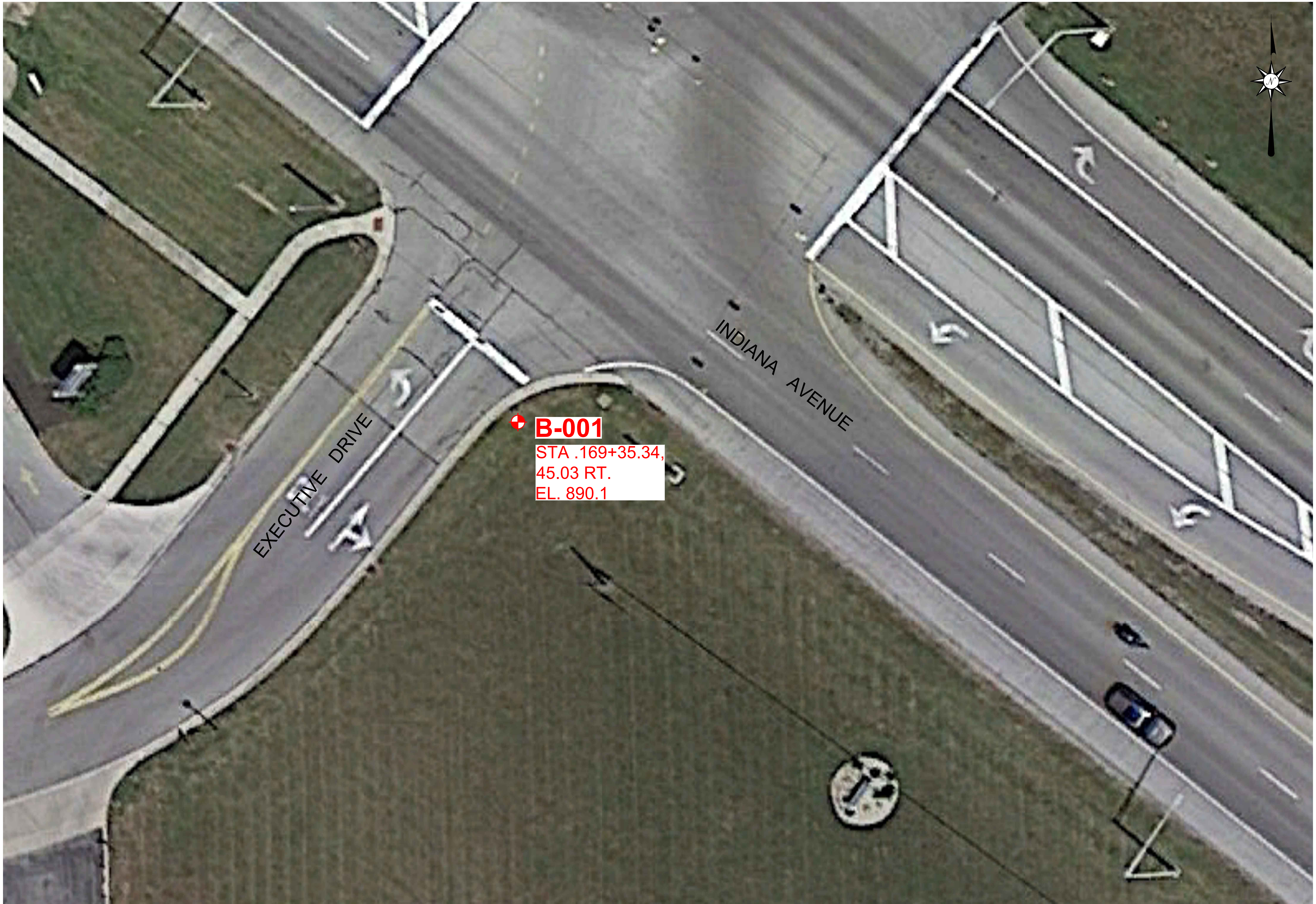
Soil Study for Proposed Mast Arm Signal Support
Indiana Avenue,
Saint Marys, Auglaize County, Ohio

For: Choice One Engineering

09-2024 EM

PROJECT NO.	215746
SCALE	1" = 1/2 Mile
FIGURE NO.	1

BOWSER MORNER



BOWSER MORNER.

PROJECT NO.
215746

SCALE
1" = 20'

FIGURE NO.
2

09-2024 EM

BORING LOCATION PLAN

Soil Study for Proposed Mast Arm Signal Support
Indiana Avenue,
Saint Marys, Auglaize County, Ohio

For: Choice One Engineering

APPENDIX B:

BORING LOGS

PROJECT: AUG-SMA-2204-INDIANA WALKS	DRILLING FIRM / OPERATOR: CS / BS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 169+35, 45' RT.
TYPE: LIGHT TOWER	SAMPLING FIRM / LOGGER: BMI / CR	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: CL
PID: SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 7/18/24	ELEVATION: 890.1 (MSL) EOB: 35.0 ft.
START: 7/16/24 END: 7/16/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 40.552722, 84.408028

EXPLORATION ID B-001-0-24

MATERIAL DESCRIPTION AND NOTES	ELEV. 890.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	889.1																	
STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, TRACE COBBLES, DAMP		1–2	3 4 5	12	67	SS-1	3.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
@3.5'; HARD		4–5	10 11 12	31	89	SS-2	4.00	3	6	12	34	45	29	18	11	14	A-6a (8)	
		6–7	9 11 12	31	100	SS-3	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
		9–10	8 11 15	35	100	SS-4	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, TRACE COBBLES, DAMP	879.1	11–12	7 9 11	27	100	SS-5	4.00	6	4	11	32	47	30	18	12	14	A-6a (9)	
		14–15	7 8 10	24	100	SS-6	3.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
@16.0'; STIFF		16–17	4 4 7	15	100	SS-7	3.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
@18.5'; VERY STIFF		19–20	4 5 7	16	100	SS-8	2.50	5	7	11	31	46	27	16	11	15	A-6a (8)	
		21–22	4 5 7	16	100	SS-9	2.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
		24–25	3 5 7	16	100	SS-10	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
@26.0'; STIFF		26–27	3 5 6	15	100	SS-11	2.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
@28.5'; VERY STIFF		29	4 6 7	18	100	SS-12	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	

PID:	SFN:	PROJECT: AUG-SMA-2204-INDIANA WALKS	STATION / OFFSET: 169+35, 45' RT.	START: 7/16/24	END: 7/16/24	PG 2 OF 2	B-001-0-24

MATERIAL DESCRIPTION AND NOTES	ELEV. 860.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, TRACE COBBLES, DAMP *(continued)*		31																
		32	5 6 9	20	100	SS-13	2.50	-	-	-	-	-	-	-	-	17	A-6a (V)	
		33																
	855.1	34 / EOB 35	5 7 8	20	100	SS-14	3.50	-	-	-	-	-	-	-	-	16	A-6a (V)	

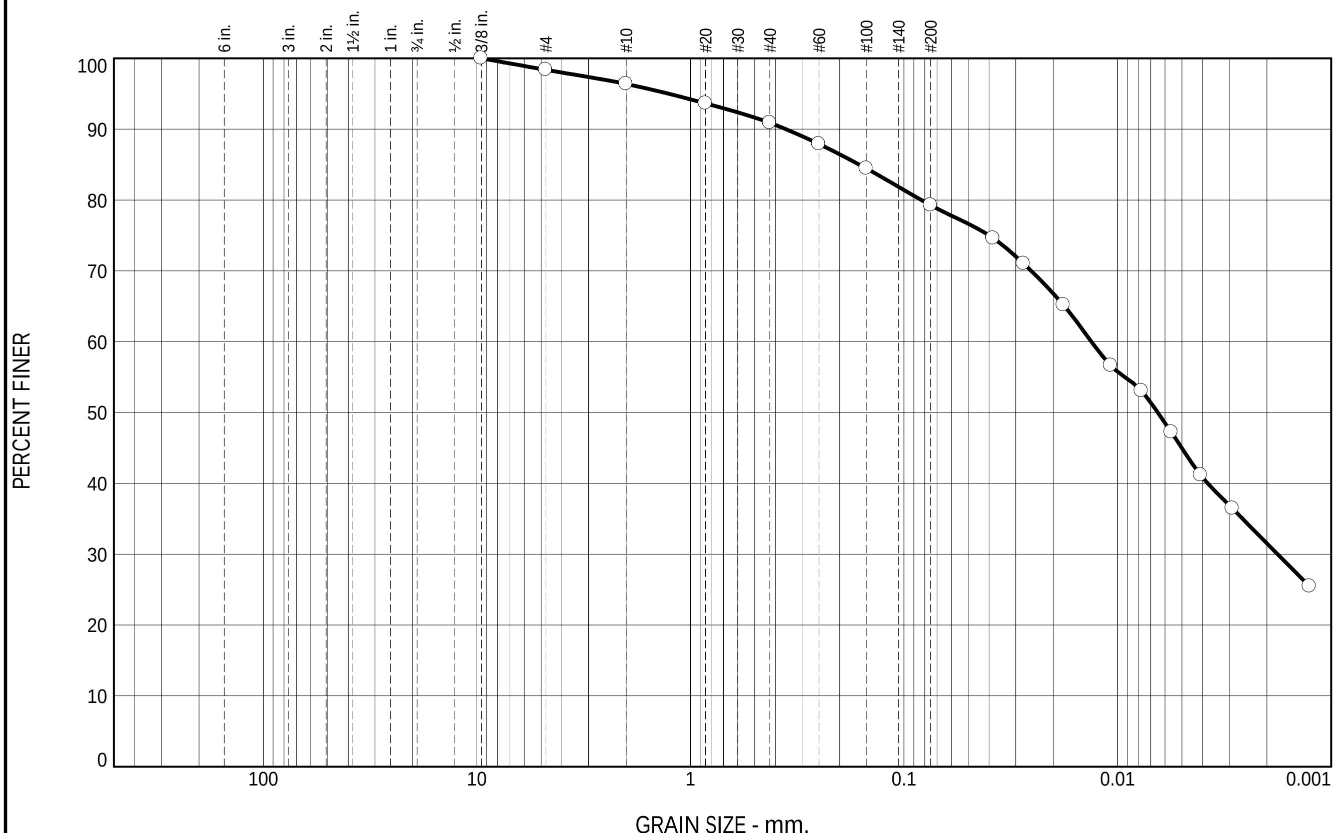
NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: MIXED WITH AUGER CUTTINGS; MIXED WITH BENTONITE CHIPS

APPENDIX C:

LABORATORY DATA

GRAIN SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	2.0	5.5	11.6	47.8	31.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.4		
#10	96.4		
#20	93.6		
#40	90.9		
#60	87.9		
#100	84.4		
#200	79.3		

* (no specification provided)

Material Description

light brown and gray SILT and CLAY, little Sand, trace Gravel

Atterberg Limits

PL= 18 LL= 29 PI= 11

Coefficients

D_{85}= 0.1622 D_{60}= 0.0133 D_{50}= 0.0065
D_{30}= 0.0018 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL ODOT= A-6a(8)

Remarks

As Received
Moisture Content: 13.9%

Location: B-001
Sample Number: SS-2 Depth: 3.5' - 5.0' Date:

BOWSER-MORNER, INC. Dayton, Ohio	Client: Choice One Engineers Project: Proposed Signal Support Project No: 215746

Tested By: MR/OR/CC Checked By: BLC

GRAIN SIZE DISTRIBUTION TEST DATA

8/15/2024

Client: Choice One Engineers
Project: Proposed Signal Support
Project Number: 215746
Location: B-001
Depth: 3.5' - 5.0'   Sample Number: SS-2
Material Description: light brown and gray SILT and CLAY, little Sand, trace Gravel
PL: 18   LL: 29   PI: 11
USCS Classification: CL   AASHTO Classification: A-6(7)
Ohio DOT Classification: A-6a(8)
Testing Remarks: As Received
Moisture Content: 13.9%
Tested by: MR/OR/CC   Checked by: BLC

Sieve Test Data (ASTM D422)

Test Date: 7/25/24   Technician: MR/OR/CC
Test remarks: As Received
Moisture Content: 13.9%

Sample #1

Total Specimen Weights
Dry specimen+tare (gms.) = 345.35
Tare (gms.) = 113.54

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing
.375	0.00	100.0
#4	3.77	98.4
#10	8.39	96.4

Sample #2

Specimen Weights
Dry specimen+tare (gms.) = 53.05
Tare (gms.) = 0.00

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing	Percent of Fines
#20	1.51	93.6	97.2
#40	3.02	90.9	94.3
#60	4.67	87.9	91.2
#100	6.57	84.4	87.6
#200	9.42	79.3	82.2

Hydrometer Test Data (ASTM D422)

Percent passing #10 based upon complete sample = 96.4

Weight of hydrometer specimen (gms.) = 53.95

Hygroscopic moisture correction:

Moist weight and tare = 50.46

Dry weight and tare = 50.13

Tare weight = 30.41

Hygroscopic moisture = 1.7%

Automatic temperature correction

Composite correction (fluid density and meniscus height) at 20 deg. C = -6.0

Meniscus correction only = 0.00

Specific gravity of solids = 2.70

Hydrometer type = 152H

Hydrometer effective depth equation: L = 16.294964 - 0.164 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	22.5	47.00	41.53	8.6	0.0382	74.6
2.00	22.5	45.00	39.53	8.9	0.0275	71.0
5.00	22.5	41.75	36.28	9.4	0.0179	65.2
15.00	22.5	37.00	31.53	10.2	0.0108	56.7
30.00	22.5	35.00	29.53	10.6	0.0077	53.1
60.00	22.5	31.75	26.28	11.1	0.0056	47.2
120.00	22.0	28.50	22.91	11.6	0.0041	41.2
250.00	21.5	26.00	20.29	12.0	0.0029	36.5
1440.00	21.0	20.00	14.18	13.0	0.0013	25.5

Results

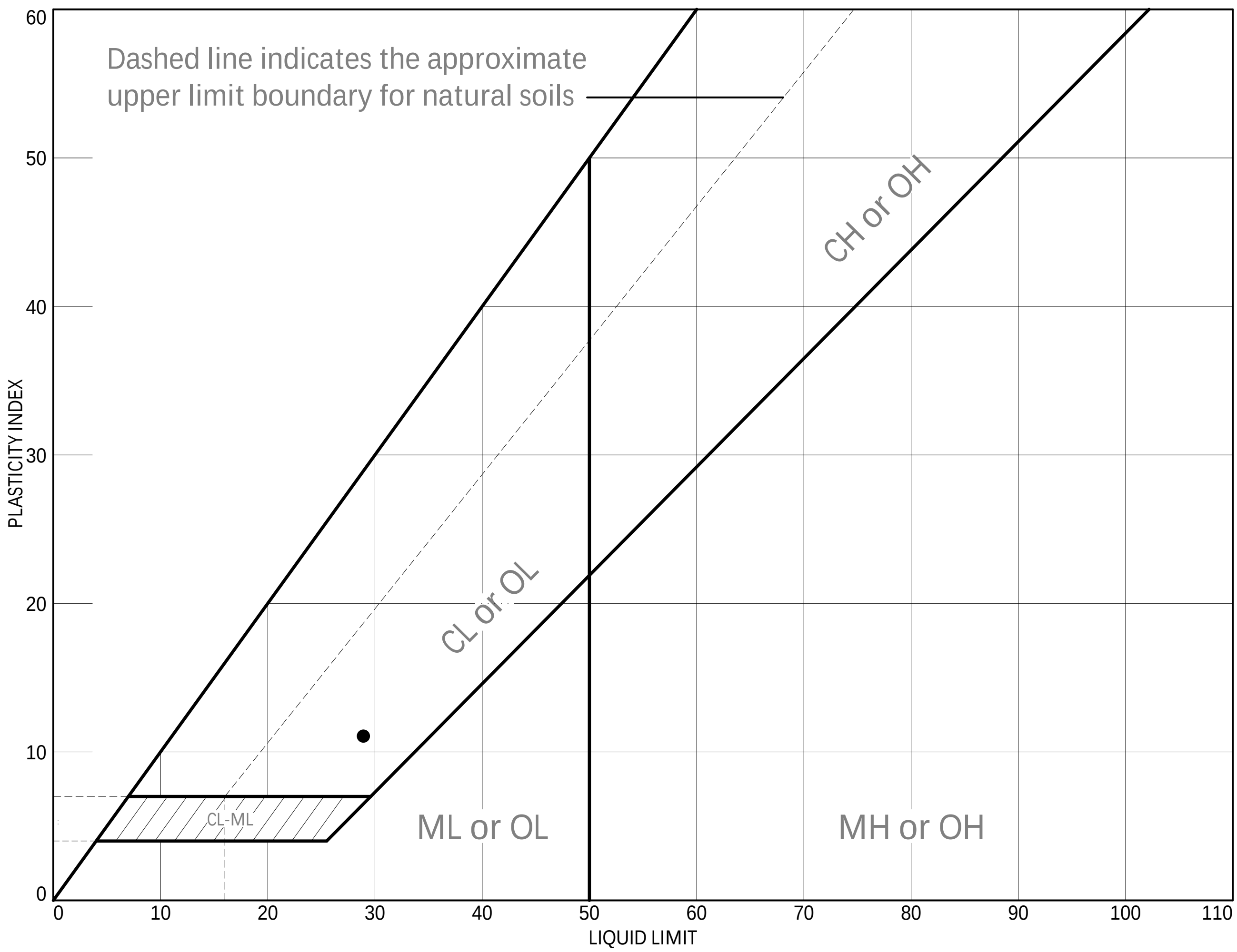
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.6	1.6	2.0	5.5	11.6	19.1	47.8	31.5	79.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0018	0.0038	0.0065	0.0133	0.0829	0.1622	0.3572	1.2652

Fineness Modulus

0.44

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	light brown and gray SILT and CLAY, little Sand, trace Gravel	29	18	11	90.9	79.3	CL

Project No. 215746 Client: Choice One Engineers

Project: Proposed Signal Support

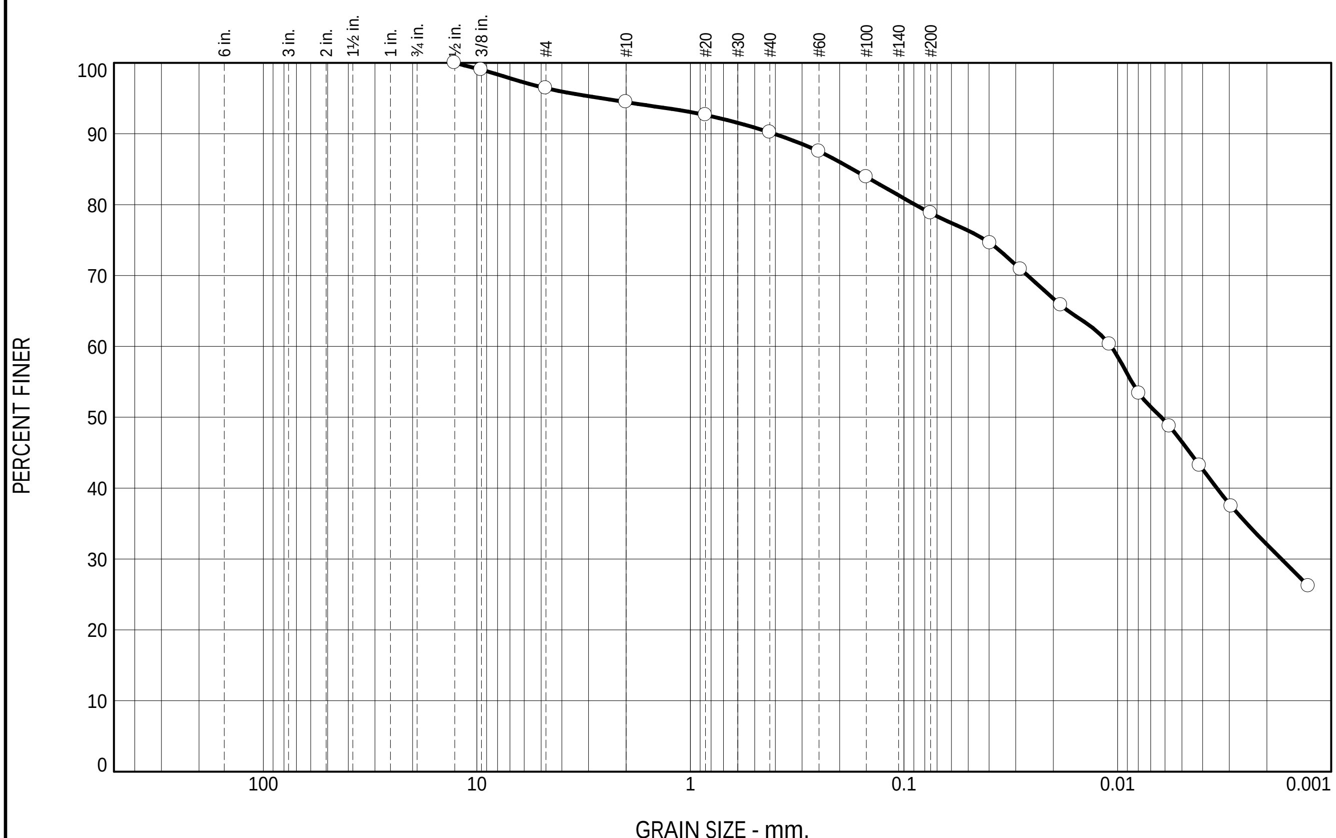
● Location: B-001 Depth: 3.5' - 5.0' Sample Number: SS-2

Remarks:

BOWSER-MORNER, INC.

Dayton, Ohio

GRAIN SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	1.9	4.3	11.4	46.7	32.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.50	100.0		
.375	99.0		
#4	96.4		
#10	94.5		
#20	92.6		
#40	90.2		
#60	87.5		
#100	83.9		
#200	78.8		

* (no specification provided)

Material Description

light grayish brown SILT and CLAY, little Sand, trace Gravel

Atterberg Limits

PL= 18 LL= 30 PI= 12

Coefficients

D_{85}= 0.1744 D_{60}= 0.0107 D_{50}= 0.0062
D_{30}= 0.0017 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL ODOT= A-6a(9)

Remarks

As Received
Moisture Content: 14.3%

Location: B-001
Sample Number: SS-5 Depth: 11.0' - 12.5' Date:

BOWSER-MORNER, INC.

Dayton, Ohio

Client: Choice One Engineers
Project: Proposed Signal Support

Project No: 215746

Tested By: MR/OR/CC Checked By: BLC

GRAIN SIZE DISTRIBUTION TEST DATA 8/15/2024

Client: Choice One Engineers
Project: Proposed Signal Support
Project Number: 215746
Location: B-001
Depth: 11.0' - 12.5' Sample Number: SS-5
Material Description: light grayish brown SILT and CLAY, little Sand, trace Gravel
PL: 18 LL: 30 PI: 12
USCS Classification: CL AASHTO Classification: A-6(8)
Ohio DOT Classification: A-6a(9)
Testing Remarks: As Received
Moisture Content: 14.3%
Tested by: MR/OR/CC Checked by: BLC

Sieve Test Data (ASTM D422)

Test Date: 7/25/24 Technician: MR/OR/CC
Test remarks: As Received
Moisture Content: 14.3%

Sample #1

Total Specimen Weights
Dry specimen+tare (gms.) = 340.59
Tare (gms.) = 114.12

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing
.50	0.00	100.0
.375	2.20	99.0
#4	8.10	96.4
#10	12.53	94.5

Sample #2

Specimen Weights
Dry specimen+tare (gms.) = 50.64
Tare (gms.) = 0.00

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing	Percent of Fines
#20	0.98	92.6	98.1
#40	2.29	90.2	95.5
#60	3.73	87.5	92.6
#100	5.67	83.9	88.8
#200	8.40	78.8	83.4

Hydrometer Test Data (ASTM D422)

Percent passing #10 based upon complete sample = 94.5

Weight of hydrometer specimen (gms.) = 51.25

Hygroscopic moisture correction:

Moist weight and tare = 51.65

Dry weight and tare = 51.40

Tare weight = 31.22

Hygroscopic moisture = 1.2%

Automatic temperature correction

Composite correction (fluid density and meniscus height) at 20 deg. C = -4.0

Meniscus correction only = 0.00

Specific gravity of solids = 2.70

Hydrometer type = 152H

Hydrometer effective depth equation: L = 16.294964 - 0.164 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	22.0	44.00	40.41	9.1	0.0395	74.6
2.00	22.0	42.00	38.41	9.4	0.0284	70.9
5.00	22.0	39.25	35.66	9.9	0.0184	65.8
15.00	22.0	36.25	32.66	10.3	0.0109	60.3
30.00	22.0	32.50	28.91	11.0	0.0079	53.4
60.00	22.0	30.00	26.41	11.4	0.0057	48.8
120.00	22.0	27.00	23.41	11.9	0.0041	43.2
250.00	21.5	24.00	20.29	12.4	0.0029	37.5
1440.00	21.0	18.00	14.18	13.3	0.0013	26.2

Results

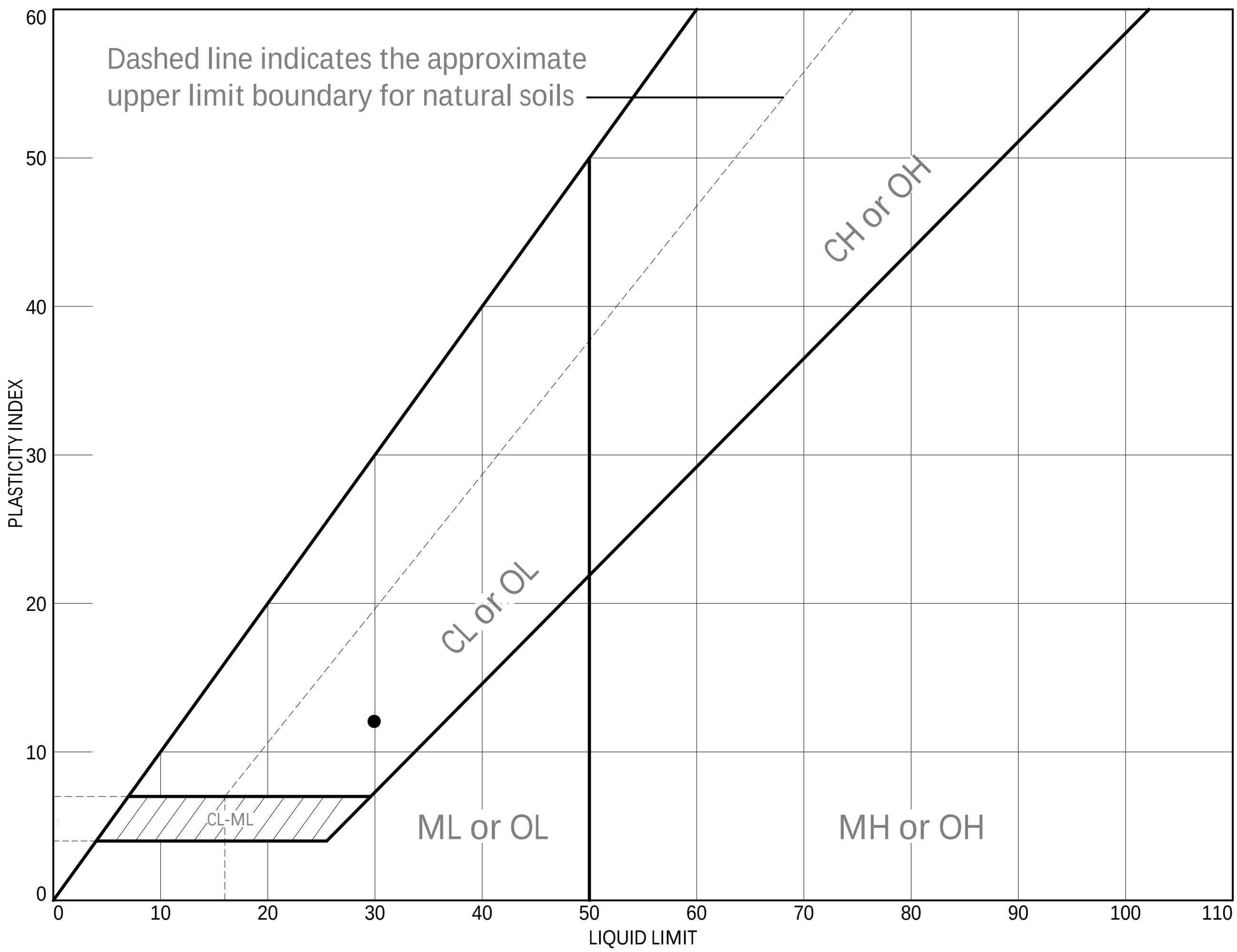
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	3.6	3.6	1.9	4.3	11.4	17.6	46.7	32.1	78.8

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0017	0.0034	0.0062	0.0107	0.0887	0.1744	0.4063	2.5852

Fineness Modulus

0.52

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	light grayish brown SILT and CLAY, little Sand, trace Gravel	30	18	12	90.2	78.8	CL

Project No. 215746 Client: Choice One Engineers

Project: Proposed Signal Support

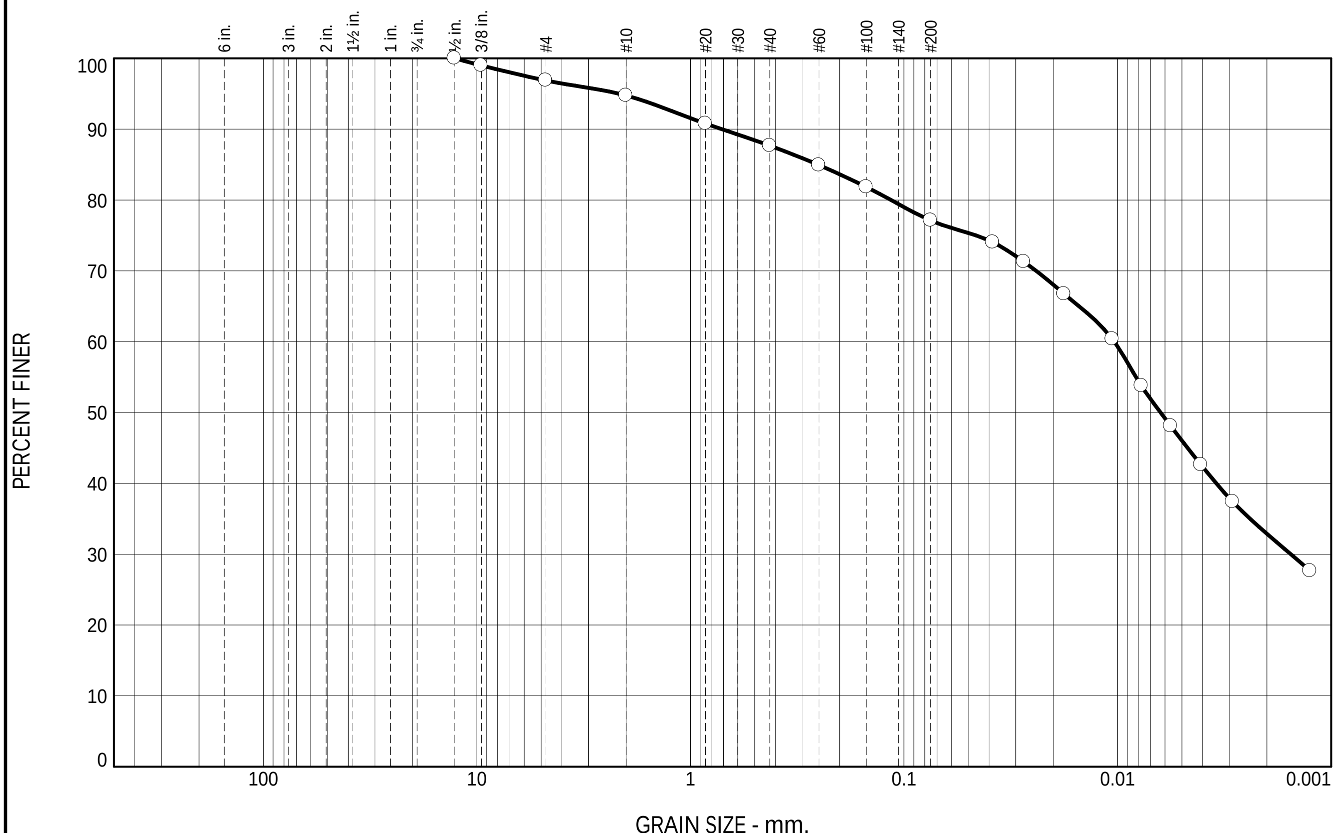
● Location: B-001 Depth: 11.0' - 12.5' Sample Number: SS-5

Remarks:

BOWSER-MORNER, INC.

Dayton, Ohio

GRAIN SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	2.2	7.0	10.6	44.2	32.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.50	100.0		
.375	99.0		
#4	96.9		
#10	94.7		
#20	90.8		
#40	87.7		
#60	84.9		
#100	81.8		
#200	77.1		

* (no specification provided)

Material Description

gray SILT and CLAY, little Sand, trace Gravel

Atterberg Limits

PL= 16 LL= 27 PI= 11

Coefficients

D_{85}= 0.2536 D_{60}= 0.0103 D_{50}= 0.0063
D_{30}= 0.0015 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL ODOT= A-6a(8)

Remarks

As Received
Moisture Content: 15.4%

Location: B-001
Sample Number: SS-8 Depth: 18.5' - 20.0' Date:

BOWSER-MORNER, INC.

Dayton, Ohio

Client: Choice One Engineers
Project: Proposed Signal Support

Project No: 215746

Tested By: MR/OR/CC Checked By: BLC

GRAIN SIZE DISTRIBUTION TEST DATA 8/15/2024

Client: Choice One Engineers
Project: Proposed Signal Support
Project Number: 215746
Location: B-001
Depth: 18.5' - 20.0' Sample Number: SS-8
Material Description: gray SILT and CLAY, little Sand, trace Gravel
PL: 16 LL: 27 PI: 11
USCS Classification: CL AASHTO Classification: A-6(6)
Ohio DOT Classification: A-6a(8)
Testing Remarks: As Received
Moisture Content: 15.4%
Tested by: MR/OR/CC Checked by: BLC

Sieve Test Data (ASTM D422)

Test Date: 7/25/24 Technician: MR/OR/CC
Test remarks: As Received
Moisture Content: 15.4%

Sample #1

Total Specimen Weights
Dry specimen+tare (gms.) = 323.89
Tare (gms.) = 95.70

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing
.50	0.00	100.0
.375	2.29	99.0
#4	7.15	96.9
#10	11.99	94.7

Sample #2

Specimen Weights
Dry specimen+tare (gms.) = 51.49
Tare (gms.) = 0.00

Cumulative pan tare (gms.) = 0.00

Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Passing	Percent of Fines
#20	2.15	90.8	95.8
#40	3.85	87.7	92.5
#60	5.34	84.9	89.6
#100	7.02	81.8	86.4
#200	9.58	77.1	81.4

Hydrometer Test Data (ASTM D422)

Percent passing #10 based upon complete sample = 94.7

Weight of hydrometer specimen (gms.) = 51.95

Hygroscopic moisture correction:

Moist weight and tare = 57.96

Dry weight and tare = 57.77

Tare weight = 37.26

Hygroscopic moisture = 0.9%

Automatic temperature correction

Composite correction (fluid density and meniscus height) at 20 deg. C = -6.0

Meniscus correction only = 0.00

Specific gravity of solids = 2.70

Hydrometer type = 152H

Hydrometer effective depth equation: L = 16.294964 - 0.164 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	46.00	40.66	8.8	0.0383	74.0
2.00	23.0	44.50	39.16	9.0	0.0275	71.3
5.00	23.0	42.00	36.66	9.4	0.0178	66.7
15.00	23.0	38.50	33.16	10.0	0.0106	60.3
30.00	22.5	35.00	29.53	10.6	0.0077	53.7
60.00	22.0	32.00	26.41	11.0	0.0056	48.0
120.00	22.0	29.00	23.41	11.5	0.0041	42.6
250.00	21.5	26.25	20.54	12.0	0.0029	37.4
1440.00	21.0	21.00	15.18	12.9	0.0013	27.6

Results

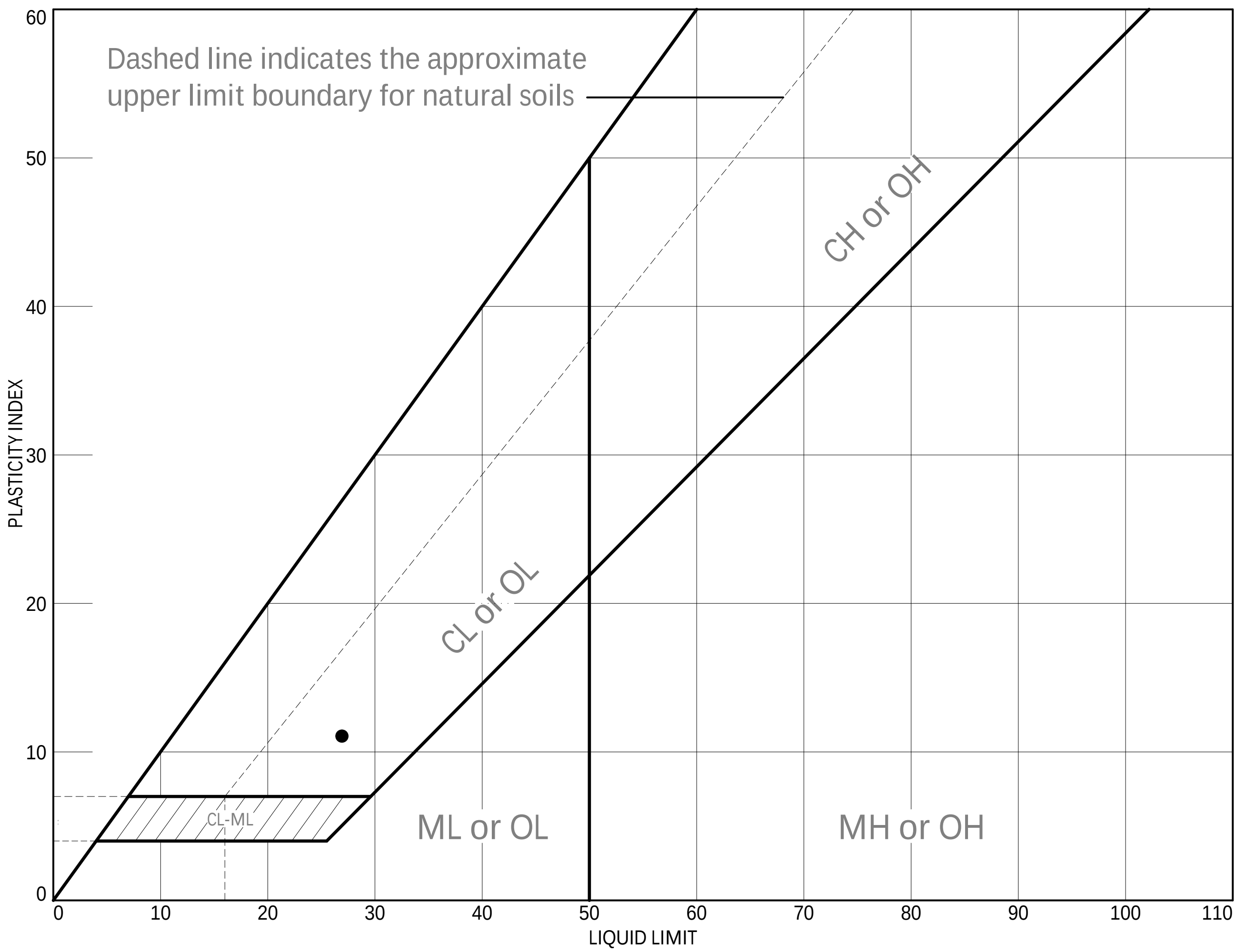
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	3.1	3.1	2.2	7.0	10.6	19.8	44.2	32.9	77.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0015	0.0035	0.0063	0.0103	0.1151	0.2536	0.7127	2.1588

Fineness Modulus

0.60

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	gray SILT and CLAY, little Sand, trace Gravel	27	16	11	87.7	77.1	CL

Project No. 215746 Client: Choice One Engineers

Project: Proposed Signal Support

● Location: B-001 Depth: 18.5' - 20.0' Sample Number: SS-8

Remarks:

BOWSER-MORNER, INC.

Dayton, Ohio

Moisture Content of Soil

ASTM (D-2216)

BOWSER MORNER

Client: Choice One Engineering
Project: Proposed Signal Support

Work Order No.: 215746
Date: 08/15/24

Boring Number	Sample Number	Depth, (ft)	Depth, (m)	Moisture Content, (%)
B-001	SS 1	1.0 - 2.5	0.3 - 0.8	15.8
	SS 2	3.5 - 5.0	1.1 - 1.5	13.9
	SS 3	6.0 - 7.5	1.8 - 2.3	15.1
	SS 4	8.5 - 10.0	2.6 - 3.0	15.2
	SS 5	11.0 - 12.5	3.4 - 3.8	14.3
	SS 6	13.5 - 15.0	4.1 - 4.6	14.7
	SS 7	16.0 - 17.5	4.9 - 5.3	15.6
	SS 8	18.5 - 20.0	5.6 - 6.1	15.4
	SS 9	21.0 - 22.5	6.4 - 6.9	16.0
	SS 10	23.5 - 25.0	7.2 - 7.6	16.0
	SS 11	26.0 - 27.5	7.9 - 8.4	16.2
	SS 12	28.5 - 30.0	8.7 - 9.1	16.6
	SS 13	31.0 - 32.5	9.4 - 9.9	16.7
	SS 14	33.5 - 35.0	10.2 - 10.7	16.1

APPENDIX D:

ENGINEERING CALCULATIONS

SOIL BEARING CAPACITY ANALYSIS

Structure:	Foundation - B-001
Project:	Mast Arm Signal
Location.:	Indiana Avenue, St. Marys, Ohio
ODOT ID:	AUG-SMA-2204-INDIANA WALKS
County:	Auglaize County, Ohio

DATA

1. Bottom of foundation is at an approximate depth of 3 to 3.5 feet below grade.

2. Groundwater is not likely be expected to be encountered during construction of foundation.

SOIL BEARING CAPACITY

The soils below the footings consist of silt & clay.

Unconfined Compression value is estimated as Qu =1,200 psf
Width of footing = Not Applicable
Cu = 2,200 / 2 = 1100 psf   Unit Weight of soil = 120 pcf

Nominal Bearing Resistance, $q_n = c N_c + \gamma D_f N_q + 0.5\gamma B N_\gamma$

For Phi = 0, Nc =5.14 (Meyerhof) Worst case scenario
Resistance Factor Øb = N/A

Nominal Bearing Resistance, qn = cNc = 5.14 x 1100 = 5,654 psf

USE qn =4,000 psf for design purposes