GEOTECHNICAL EXPLORATION REPORT

GEA-528-10.71/14.87
MIDDLEFIELD AND MONTVILLE, OHIO

SME Project Number: 092062.07
January 5, 2024

SME

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January 5, 2024

Mr. Kyle J. Dohlen, PE
Transportation Engineer
Planning and Engineering
ODOT District 12
5500 Transportation Boulevard
Garfield Heights, Ohio 44125

Via E-Mail: Kyle.Dohlen@dot.ohio.gov

RE: GEA-528-10.71/14.87
VAR-District 12/District 3 Subs Inv for Pvmt & Bridges
PID No. 115048
Task D-12-7

Dear Mr. Dohlen:

The attached Geotechnical Exploration report presents the results of our exploration for the temporary earth retention systems for two culvert replacement projects along GEA-528 (Madison Road) in Middlefield and Montville, Ohio.

If you have questions, please call.

Sincerely,

SME

Brendan P. Lieske, PE
Senior Consultant

Enclosed: SME Geotechnical Report Dated: January 5, 2024

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EXECUTIVE SUMMARY

This report represents the results of a subgrade exploration for two culvert replacements along GEA-528 (Madison Road) in Middlefield and Montville, Ohio. This exploration specifically focused on providing recommendations for temporary earth retention for construction. Subsurface conditions were evaluated by drilling two Standard Penetration Test (SPT) borings, one at each culvert location, designated B-001-0-23 and B-002-0-23, which were extended to depths of 35 and 25 feet below the pavement surface respectively. The borings were performed in general accordance with the current ODOT Specifications for Geotechnical Explorations. Soil samples from the borings were taken to our laboratory for visual classification and testing.

The pavement section within the limits of this project generally consisted of seven inches of asphalt and five inches of aggregate base. Below the pavement materials in B-001-0-23 we encountered possible fill soils. The fill material consisted of sandy silt and silt and clay (A-4a and A-6a) with trace organics encountered near the bottom of the fill layer. Below the pavement materials and fill we encountered mostly cohesive fine-grained glacial till soils consisting of either sandy silt (A-4a) or silt and clay (A-6a). These soils had stiff to hard strengths. The soils were brown in the upper profile and transitioned to gray color at a depth of 16.5 feet in B-001-0-23 and 13 feet in B-002-0-23. In B-001-0-23 we encountered a layer of gray, medium dense, gravel with sand and silt between 28.5 and 33 feet. Bedrock was not encountered in either boring at the maximum boring depths of 25 and 35 feet.

Groundwater was encountered during drilling at a depth of nine feet in each boring. In B-002-0-23, the borehole was dry after completion of drilling. In B-001-0-23, the groundwater level in the borehole was at a depth of 33 feet after drilling. After the augers were removed from the B-001-0-23 borehole, groundwater was measured at a depth of 28 feet and caving of the borehole occurred at about 30 feet. The groundwater encountered at a depth of nine feet appears to be perched groundwater within sand seams and sandier silt soils. In fine-grained soils, such as these, a long time may be required for the groundwater level in the borehole to reach an equilibrium position. However, a color change from brown to gray in clay is oftentimes an indicator of long-term groundwater level.

The anticipated soil conditions for the culvert excavations will consist of stiff to hard cohesive soils. These soils are classified as OSHA Type A soils. Excavations through Type A soils should be sloped at a ratio no steeper than 0.75 feet horizontally for each foot of vertical change (0.75H:1V). In B-001-0-23, medium dense sands, which is considered OSHA Type B, were encountered at a depth of 29.5 feet. Although not anticipated based on the planned invert depths, excavations through these Type B soils should be sloped at a ratio no steeper than 1.0 foot horizontally for each foot of vertical change (1H:1V).

Groundwater seepage into the culvert excavations should be anticipated around a depth of nine feet based on the boring information. This groundwater is likely from perched conditions with water trapped above the more fine-grained, very stiff to hard glacial till soils. If groundwater is encountered, the contractor should be prepared to manage groundwater in excavations by temporarily lowering the groundwater levels with a dewatering system. Based on the planned invert elevations between 7 and 9.4 feet, conventional sump pit and pump methods in conjunction with a cofferdam system is expected to be adequate for controlling groundwater seepage.

To limit the disturbance to the pavements and other utilities in the road and right-of-way, we assume excavation trenches for the new culvert construction will include trench boxes that can be moved as the work progresses or some other form of temporary braced shoring. The shoring system should be designed for the equivalent fluid at-rest earth pressures provided in Tables 3 and 4 of this report, plus the effect of any surcharges from construction equipment or stored and stockpiled materials.

The summary presented above includes selected elements of our findings and recommendations and is provided solely for purposes of overview. It does not present details needed for the proper application of our findings and recommendations. This summary should not be used without reading and understanding the assumptions in the entire report.

1. INTRODUCTION

This report represents the results of a geotechnical exploration for two culvert replacements along GEA-528 (Madison Road) in Middlefield and Montville, Ohio. Specifically, this report includes recommendations for temporary earth retention to be designed and used during construction of the new culverts. Per the plan sheets provided by ODOT, the proposed culverts will be 48-inch Type A conduit. The further north culvert location (GEA-528-14.87) will be 50 feet long and have an invert depth of about 9.4 feet at the road centerline. The further south location (GEA-528-10.71) will be 90 feet long and have an invert depth of about seven feet at the road centerline.

Subsurface conditions were evaluated by drilling two Standard Penetration Test (SPT) borings, designated B-001-0-23 and B-002-0-23, which were extended to depths of 35 and 25 feet respectively. The borings were performed in general accordance with the current ODOT Specifications for Geotechnical Explorations.

2. GEOLOGY AND OBSERVATIONS

2.1 GEOLOGY

Geologic references for the Montville project area (GEA-528-14.87) indicate soils consisting of glacial till end and ground moraine deposits from the Late Wisconsinan period. Based on local geology references, the glacial till deposits extend from the ground surface down to bedrock. Bedrock in this area consists of Pennsylvanian Age shale, siltstone, sandstone, and conglomerate. Bedrock depths vary through the area but are estimated to be between about 50 and 100 feet below the ground surface.

Similar to the Montville location, geologic references for the Middlefield project area (GEA-528-10.71) indicate soils consisting of glacial till end and ground moraine deposits from the Late Wisconsinan period. Based on local geology references, layers of sand and gravel may be present beneath the glacial till deposits and above the bedrock. Bedrock in this area consists of Pennsylvanian Age shale, siltstone, sandstone, and conglomerate.

2.2 RECONNAISSANCE

SME visited the project sites on November 13, 2023, to perform site reconnaissance and mark the boring locations. The roadway at both locations at the time of our exploration consisted of asphalt pavement with two lanes and shoulders. We did not perform any observation of the existing buried culverts during our reconnaissance. Based on the provided information, the existing culvert at the Middlefield location consists of a 58-inch by 36-inch corrugated metal pipe arch. The existing culvert at the Montville location consists of a 42-inch corrugated metal pipe.

2.3 EXISTING DATA

We reviewed the ODOT TIMS database and found no relevant historical boring information for these sites. There are pavement subgrade borings completed in 1961 near the Middlefield location for the initial construction of SR 528. Because of the date the borings were completed, and shallow exploration depths, we did not include these borings in our analysis.

3. EXPLORATION

3.1 FIELD EXPLORATION

SME visited the site on November 14, 2023, to perform the field exploration. Subgrade conditions were identified by two Standard Penetration Test (SPT) borings, designated as B-001-0-23 at the Middlefield location and B-002-0-23 at the Montville location. The borings were extended to depths of 35 feet at B-001-0-23 and 25 feet at B-002-0-23. SME obtained split-spoon samples at 2.5-foot intervals through the termination depth at each boring. We also obtained two thin-walled Shelby tubes in B-001-0-23. The boring locations are shown on the attached Boring Location Diagrams.

Drilling equipment consisted of a CME-55 truck rig with a CME auto hammer having an energy transfer ratio of 77 percent based on our August 5, 2022, calibration. The field-measured blowcounts are corrected to N_{60} based on the transfer energy of the hammer system. Both the field-measured blowcounts for each six-inch penetration interval, and the energy-corrected blowcounts in blows per foot, are reported on the boring logs. SME checked the boreholes for the presence of groundwater during drilling and prior to backfilling. The boreholes were backfilled with a blend of auger cuttings and bentonite chips and the surface was patched with asphalt cold patch.

3.2 LABORATORY TESTING

Samples were placed in clean glass jars each marked with project number, boring number, depth interval, and blowcount data. The samples were taken to our laboratory where they were classified in accordance with the ODOT-modified AASHTO procedure. Laboratory testing included water contents on all SPT samples, mechanical sieve and hydrometer tests on 11 representative soil samples. The results of the lab tests are reported on the attached boring logs and laboratory test reports included in *Appendix A*.

4. FINDINGS

4.1 SUBSURFACE CONDITIONS

The surface material at the borings consisted of about seven inches of asphalt over five inches of aggregate base. Possible fill material was encountered to a depth of 11 feet in B-001-0-23. The fill material consisted of sandy silt and silt and clay (A-4a and A-6a). Trace organics were encountered near the bottom of the fill. Below the pavement materials and fill we encountered mostly cohesive fine-grained soils consisting of either sandy silt (A-4a) or silt and clay (A-6a). These soils had stiff to hard strengths. The soils were brown in the upper profile and transitioned to gray color at a depth of 16.5 feet in B-001-0-23 and 13 feet in B-002-0-23. In B-001-0-23 we encountered a layer of gray, medium dense, gravel with sand and silt between 28.5 and 33 feet. Bedrock was not encountered in either boring at the maximum boring depths of 25 and 35 feet.

Groundwater was encountered during drilling at a depth of nine feet in each boring. In B-002-0-23, the borehole was dry after completion of drilling. In B-001-0-23, the groundwater level in the borehole was at a depth of 33 feet after drilling. After the augers were removed from the borehole, groundwater was measured at a depth of 28 feet and caving of the borehole occurred at about 30 feet. The groundwater encountered at a depth of nine feet appears to be perched groundwater within sand seams and sandier silt soils. The soils below this depth are more fine-grained glacial till soils that are less permeable to groundwater flow. In fine-grained soils, such as these, a long time may be required for the groundwater level in the borehole to reach an equilibrium position. However, a color change from brown to gray in clay is oftentimes an indicator of long-term groundwater level.

Groundwater levels should be expected to fluctuate during the year based on variations in precipitation, run-off, and other factors. Groundwater conditions indicated by the borings represent conditions at the time the readings were taken. Groundwater levels at other times may vary from those conditions noted on the boring logs.

5. ANALYSES AND RECOMMENDATIONS

5.1 SOIL DESIGN PARAMETERS

The following soil parameters were developed using the SPT data from the borings, laboratory testing, correlations from the ODOT Geotechnical Design Manual (July 2023), AASHTO LRFD Bridge Design Specifications (2020), and our engineering experience. Material properties used in our analysis are listed in Tables 1 and 2.

TABLE 1: B-001-0-23 SOIL DESIGN PARAMETERS

MATERIAL DESCRIPTION	TOP DEPTH (± FT)	BOTTOM DEPTH (± FT)	UNIT WEIGHT (PCF)	EFFECTIVE UNIT WEIGHT (PCF)	UNDRAINED SHEAR STRENGTH (PSF)	FRICTION ANGLE
Brown and Gray Silt and Clay (A-4a, A-6a)	0	11	120	125	1600	n/a
Brown Glacial Till (A-6a)	11	16.5	125	125	2500	n/a
Gray Glacial Till (A-4a)	16.5	29.5	130	68	3000	n/a
Gray Gravel (A-2-4)	29.5	33	125	63	0	35
Gray Glacial Till (A-4a)	33	35	130	68	3300	n/a

* n/a – not applicable for undrained conditions

TABLE 2: B-002-0-23 SOIL DESIGN PARAMETERS

MATERIAL DESCRIPTION	TOP DEPTH (± FT)	BOTTOM DEPTH (± FT)	UNIT WEIGHT (PCF)	EFFECTIVE UNIT WEIGHT (PCF)	UNDRAINED SHEAR STRENGTH (PSF)
Brown Silt and Clay (A-4a, A-6a)	0	9.5	120	120	1600
Brown Glacial Till (A-6a)	9.5	13	125	125	3000
Gray Glacial Till (A-4a)	13	25	130	68	3000

5.2 EXCAVATIONS AND OSHA SOIL TYPES

The anticipated soil conditions for the culvert excavations will consist of very stiff to hard cohesive soils. These soils are classified as OSHA Type A soils. Excavations through Type A soils should be sloped at a ratio no steeper than 0.75 feet horizontally for each foot of vertical change (0.75H:1V). In B-001-0-23, medium dense sands, which is considered OSHA Type B, were encountered at a depth of 29.5 feet. Although not anticipated based on the planned invert depths, excavations through these Type B soils should be sloped at a ratio no steeper than 1.0 foot horizontally for each foot of vertical change (1H:1V).

Groundwater seepage into the culvert excavations should be anticipated around a depth of nine feet based on the boring information. This groundwater is likely from perched conditions with water trapped above the more fine-grained, very stiff to hard glacial till soils. The actual groundwater levels and the amount of perched groundwater at the time of construction could vary from the groundwater levels reported on the logs, depending on seasonal precipitation, time of year, and other factors. If groundwater is encountered, the contractor should be prepared to manage groundwater in excavations by temporarily lowering the groundwater levels with a dewatering system. Based on the planned invert elevations between 7 and 9.4 feet, conventional sump pit and pump methods in conjunction with a cofferdam system is expected to be adequate for controlling groundwater seepage.

Although it is not anticipated, if excavations extend more than two feet below the long-term static groundwater levels, estimated to be below 16.5 feet in B-001-0-23 and 13 feet in B-002-0-23, heavier groundwater flows could require higher capacity dewatering methods, such as cased wells or well points, to dewater deeper excavations.

Cofferdams consisting of steel sheet piling may be required to direct and control the flow of the creeks during the construction of the culverts. The cofferdams should be relatively water-tight and keyed into the underlying glacial till soils (sandy silt, A-4a). With the cofferdam in place, pumping from shallow sumps should be sufficient to remove water from the excavations. The design of the temporary cofferdam is typically the responsibility of the contractor. Regardless, we recommend the cofferdam design be provided by a licensed professional engineer with experience in temporary earth support.

The contractor must take precautions to protect nearby existing pavements and utilities during construction. Care must be exercised during the excavating and compacting operations so that excessive vibrations do not cause settlement of nearby existing pavements, utilities, or residences, and to avoid undermining existing utilities during excavation for the new culvert.

5.3 TEMPORARY EARTH RETENTION

To limit the disturbance to the pavements in the road and reduce the amount of excavation required, we anticipate temporary earth retention will be necessary. The sheet pile cofferdams used to control the flow from the creek can also be used for earth retention. However, excavation trenches for the new culvert construction could also include the use of trench boxes that can be moved as the work progresses or some other form of temporary braced shoring.

A braced shoring system should be designed for the equivalent fluid at-rest earth pressures provided in Tables 3 and 4, plus the effect of any surcharges from construction equipment or stored and stockpiled materials. Surcharges would result in a uniform lateral loading on the bracing equal to 0.5 times the vertical surcharge. The stated earth pressures are applicable to drained conditions based on the absence of groundwater in the upper nine feet of the borings and assuming water accumulations due to seepage (if encountered) will be dewatered from the work area. If the shoring system will be required to resist groundwater pressures, the design lateral pressures will be higher. Contact SME for additional recommendations.

TABLE 3: B-001-0-23 TEMPORARY EARTH RETENTION DESIGN PARAMETERS

MATERIAL DESCRIPTION	TOP DEPTH (± FT)	BOTTOM DEPTH (± FT)	UNIT WEIGHT (PCF)	AT-REST EARTH PRESSURE COEFFICIENT	EQUIVALENT AT-REST FLUID PRESSURE (PSF)
Brown and Gray Silt and Clay (A-4a, A-6a)	0	8	120	0.5	60
Brown Glacial Till (A-6a)	8	16.5	125	0.46	58
Gray Glacial Till (A-4a)	16.5	29.5	130	0.46	58
Gray Gravel (A-2-4)	29.5	33	125	0.46	58
Gray Glacial Till (A-4a)	33	35	130	0.46	58

TABLE 4: B-002-0-23 TEMPORARY EARTH RETENTION DESIGN PARAMETERS

MATERIAL DESCRIPTION	TOP DEPTH (± FT)	BOTTOM DEPTH (± FT)	UNIT WEIGHT (PCF)	AT-REST EARTH PRESSURE COEFFICIENT	EQUIVALENT AT-REST FLUID PRESSURE (PSF)
Brown Silt and Clay (A-4a, A-6a)	0	9.5	120	0.5	60
Brown Glacial Till (A-6a)	9.5	13	125	0.46	58
Gray Glacial Till (A-4a)	13	25	130	0.46	58

6. SIGNATURES

PREPARED BY:

STATE OF OHIO
THOMAS OLDING
E-87981
REGISTERED
PROFESSIONAL ENGINEER

Tom Olding

Thomas P. Olding, PE
Project Engineer

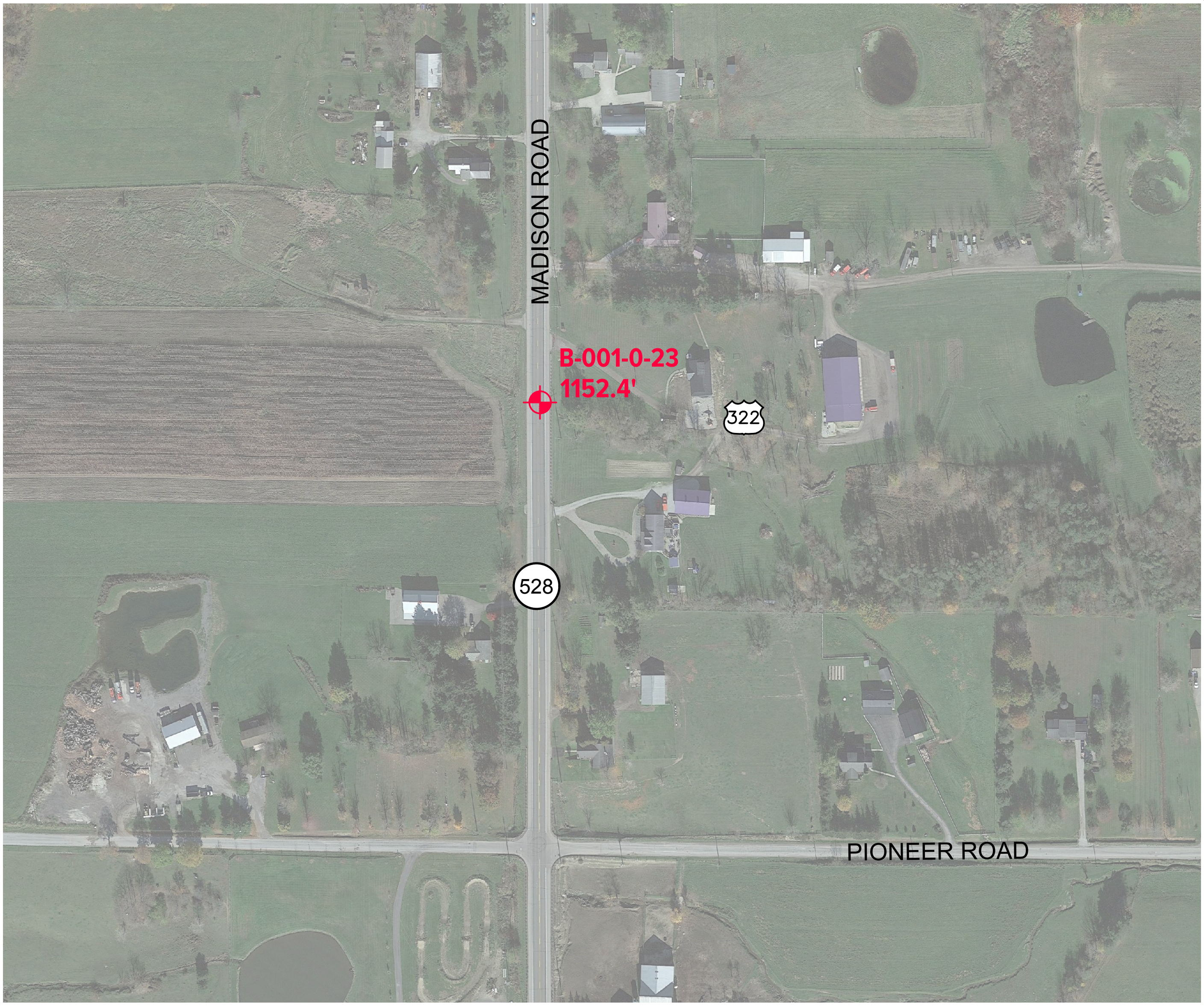
REVIEWED BY:

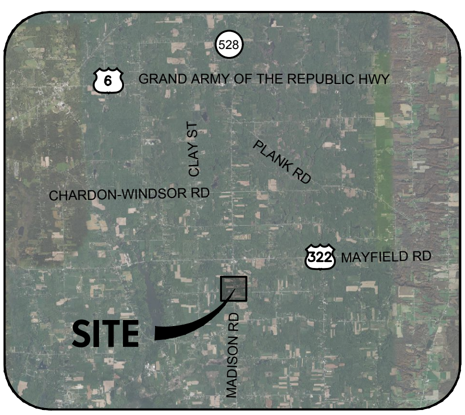
Timothy H Bedenis

Timothy H. Bedenis, PE, D.GE
Principal Consultant

APPENDIX A

BORING LOCATION DIAGRAM
ODOT BORING LOG TERMINOLOGY
BORING LOGS





LOCATION MAP

NOT TO SCALE

LEGEND

APPROXIMATE BORING LOCATION

NOTE:
1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO WITH AN IMAGE DATE OF 08-19-2020.

0' 300' 600'

GRAPHIC SCALE: 1" = 300'

No.	Revision Date		
		Date	11-20-2023
		Drawn By	CRC
		Designed By	BAM
		Scale	AS NOTED
		Project	092062.07

BORING LOCATION DIAGRAM
GEA-528-10.71/14.87 (PID 115048)
MIDDLEFIELD AND MONTVILLE, OHIO

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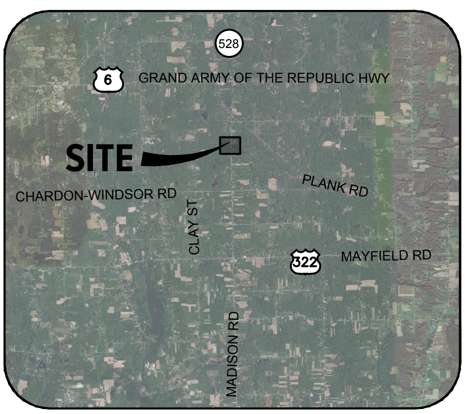
Figure No. 1



LOCATION MAP

NOT TO SCALE

LEGEND

APPROXIMATE BORING LOCATION

NOTE:

1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO WITH AN IMAGE DATE OF 08-19-2020.

0' 400' 800'

GRAPHIC SCALE: 1" = 400'

No.	Revision Date		
		Date	11-20-2023
		Drawn By	CRC
		Designed By	BAM
		Scale	AS NOTED
		Project	092062.07

BORING LOCATION DIAGRAM
GEA-528-10.71/14.87 (PID 115048)
MIDDLEFIELD AND MONTVILLE, OHIO

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Figure No. 1

Nov 20, 2023 - 2:55pm - cindy.rocha-ceron

\\sme-inc\pz\WIP\092062.07\CAD\Design Files\BLD\Rev1\092062.07-BLD.dwg

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness	
Description	**Blows Per Ft.**
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate color is shaded by a secondary color, the secondary color procedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	**Qu (TSF)**	**Blows Per Ft.**	**Hand Manipulation**
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	**Percentage By Weight**
Trace	0% - 10%
Little	10% - 20%
Some	20% - 35%
"And"	35% -50%

5) Soil Organic Content

Description	**% by Weight**
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	**Criteria**	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart. The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	$LL_O/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F S	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≦LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

- Sod and Topsoil
- Pavement or Base
- Uncontrolled Fill (Describe)
- Bouldery Zone
- P Peat

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/2/24 08:50 - \\SME-INC\PZ\WIP\092062.07\PROJECT DATA\GINT\092062.07+GEA-528-10.71 14.87 (PID 115048).GPJ

PROJECT: GEA-528-10.71/14.87	DRILLING FIRM / OPERATOR: SME / RM/ WI	DRILL RIG: CME 55 TRUCK	STATION / OFFSET:	EXPLORATION ID B-001-0-23
TYPE: CULVERT	SAMPLING FIRM / LOGGER: SME / BAM	HAMMER: CME AUTOMATIC	ALIGNMENT:	
PID: 115048 SFN:	DRILLING METHOD: 3.75" HSA	CALIBRATION DATE: 8/5/23	ELEVATION: 1152.4 (MSL) EOB: 35.0 ft.	PAGE 1 OF 2
START: 11/14/23 END: 11/14/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77	LAT / LONG: 41.523633, -81.051665	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1152.4	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
7" ASPHALT	1151.8																	
5" AGGREGATE BASE	1151.4																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, TRACE ROOTS, POSSIBLE FILL, DAMP	1149.4	1 2	3 5 5	13	67	SS-1	4.00	17	10	15	30	28	31	19	12	15	A-6a (5)	
STIFF TO VERY STIFF, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, TRACE ORGANICS, POSSIBLE FILL, MOIST		3 4 5	3 5 6	14	100	SS-2	2.50	-	-	-	-	-	-	-	-	15	A-4a (V)	
		6 7	2 2 2	5	78	SS-3	1.50	5	8	20	41	26	29	20	9	23	A-4a (6)	
Organic Content = 4.2%	1141.4	8 W 1143.4 9 10			79	ST-4	2.00	-	-	-	-	-	-	-	-	37	A-4a (V)	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		11 12	3 6 10	21	100	SS-5	3.50	6	8	13	35	38	28	17	11	17	A-6a (8)	
		13 14 15	6 7 8	19	100	SS-6	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
	1135.9	16	6			SS-7A	4.25	-	-	-	-	-	-	-	-	-	A-6a (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, OCCASIONAL SAND SEAMS, DAMP		17	8 10	23	100	SS-7B	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
		18 19 20	7 8 8	21	100	SS-8	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
		21 22 23			92	ST-9	2.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
	1126.9	24 25	5 7 10	22	100	SS-10	4.00	14	8	14	36	28	23	17	6	14	A-4a (6)	
HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL (SHALE FRAGMENTS), LITTLE CLAY, DAMP		26 27	5 7 11	23	67	SS-11	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1122.9	▼ 1124.4 28 29	4 6 9	19	100	SS-12A	-	-	-	-	-	-	-	-	-	15	A-4a (V)	
						SS-12B	-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	

PID: 115048	SFN:	PROJECT: GEA-528-10.71/14.87	STATION / OFFSET:	START: 11/14/23	END: 11/14/23	PG 2 OF 2	B-001-0-23

MATERIAL DESCRIPTION AND NOTES	ELEV. 1122.4	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
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP *(continued)*	1119.4	31–32	5 8 10	23	100	SS-13	-	21	13	32	23	11	NP	NP	NP	10	A-2-4 (0)	
VERY STIFF, GRAY, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP	1117.4	33–35 EOB	6 8 13	27	100	SS-14	3.50	18	15	21	30	16	20	16	4	12	A-4a (2)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH IN. AUGER CUTTINGS

PROJECT: GEA-528-10.71/14.87	DRILLING FIRM / OPERATOR: SME / RM/ WI	DRILL RIG: CME 55 TRUCK	STATION / OFFSET:	EXPLORATION ID B-002-0-23
TYPE: CULVERT	SAMPLING FIRM / LOGGER: SME / BAM	HAMMER: CME AUTOMATIC	ALIGNMENT:	
PID: 115048 SFN:	DRILLING METHOD: 3.75" HSA	CALIBRATION DATE: 8/5/23	ELEVATION: 1231.5 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 11/14/23 END: 11/14/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77	LAT / LONG: 41.583754, -81.051807	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1231.5	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
7" ASPHALT	1230.9																	
5" AGGREGATE BASE	1230.5																	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE TO SOME GRAVEL, MOIST	1228.5		5 4 5	12	67	SS-1	4.50	20	19	15	24	22	28	17	11	19	A-6a (3)	
STIFF TO VERY STIFF, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST			4 4 3	9	56	SS-2	3.00	-	-	-	-	-	-	-	-	22	A-4a (V)	
					83	ST-3	1.00	-	-	-	-	-	-	-	-	27	A-4a (V)	
	1222.0	W 1222.5	3 3 4	9	100	SS-4A	3.00	8	7	22	38	25	31	22	9	21	A-4a (6)	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP						SS-4B	4.50	-	-	-	-	-	-	-	-	-	A-6a (V)	
	1218.5		7 9 9	23	100	SS-5	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
VERY STIFF, GRAY, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP			5 8 11	24	100	SS-6	4.00	8	6	14	38	34	24	16	8	14	A-4a (7)	
			5 6 9	19	100	SS-7	3.00	15	11	18	32	24	23	16	7	11	A-4a (4)	
	1211.0		4 7 11	23	100	SS-8	4.00	-	-	-	-	-	-	-	-	14	A-4a (V)	
VERY STIFF, GRAY, **SANDY SILT**, AND CLAY, TRACE TO LITTLE GRAVEL, DAMP			6 7 10	22	100	SS-9	4.00	7	10	19	28	36	23	15	8	13	A-4a (6)	
	1206.5	EOB 25	4 7 8	19	100	SS-10	3.50	-	-	-	-	-	-	-	-	14	A-4a (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

GENERAL COMMENTS

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
e-mail: info@geoprofessional.org www.geoprofessional.org

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.

Passionate People Building
and Revitalizing our World

SME