Structure Foundation Exploration – FINAL
RIC-3rd St. -0313 Ritters Run Culvert
Mansfield, Richland County, Ohio
S&ME Project No. 1117-19-038

PREPARED FOR:
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January 29, 2020

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Attention: Mr. Craig Schrader, P.E.

Reference: **Structure Foundation Exploration - Final**
RIC-3rd St. -0313 Ritters Run Culvert Replacement
Mansfield, Richland County, Ohio
S&ME Project No. 1117-19-038

Mr. Schrader:

In accordance with our proposal dated March 22, 2019, which was authorized by EMH&T Inc. (EMHT) on June 18, 2019, S&ME, Inc. (S&ME) has completed a Geotechnical Exploration for the existing RIC-3rd St. -0313 Ritters Run Culvert Replacement project in Mansfield, Richland County, Ohio. The approximate location of this project is illustrated on the Vicinity Map included as Plate 1 in Appendix A of this report.

In accordance with Section 701 of the current ODOT *Specifications for Geotechnical Explorations* (*SGE*), S&ME is herewith submitting a "Final" version of this report, which is to be provided to the ODOT District Geotechnical Engineer. This version incorporates review comments on our "draft" report provided by EMH&T on January 24, 2020. Structure Foundation Exploration report plan sheets are submitted in Appendix D.

We appreciate the opportunity to be of service. Please do not hesitate to contact our office if you have any questions concerning this report.

Respectfully submitted,

S&ME, Inc.

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1.0 Executive Summary

It is proposed to replace the existing culvert which runs beneath the south side of 3rd Street, between Scott Street and Junction Street, in Mansfield, Ohio. The proposed replacement structure is to be a new 4-sided box culvert with a 16-foot span and 6-foot height. The new culvert is anticipated to follow the same or similar alignment as the existing culvert, with minimal to no regrading of the final roadway anticipated. It is understood that construction of the new culvert will require the design and installation of temporary retaining structures (e.g., sheeting/shoring).

Six borings (B-001-0-19 through B-006-0-19) were performed for the proposed replacement culvert. These new borings encountered 4 to 6 inches of existing asphalt over 6 to 8 inches of brick. Below the existing pavement, the borings generally encountered 8 to 13 feet of existing fill and possible fill which consisted variably of loose to medium-dense COARSE AND FINE SAND (A-3a) or GRAVEL WITH SAND (A-1-b), stiff to hard SANDY SILT (A-4a), and hard SILTY CLAY (A-6b). Beneath the fill, discontinuous deposits of natural soils were encountered, ranging from medium-stiff to very-stiff cohesive SANDY SILT (A-4a), SILT AND CLAY (A-6a), and SILTY CLAY (A-6b) to granular soil comprising loose to dense GRAVEL WITH SAND (A-1-b), COARSE AND FINE SAND (A-3a), GRAVEL WITH SAND AND SILT (A-2-4), and SANDY SILT (A-4a). Borings B-001, B-002 and B-006 were terminated after encountering brown, severely weathered SANDSTONE bedrock. A very-strong hydrocarbon odor was noted in Boring B-005.

Based on the results of the borings, the subsurface conditions appear suitable for supporting the planned replacement culvert on the stiff to very-stiff cohesive soil or loose to medium-dense granular soil encountered below the anticipated culvert bearing level. S&ME recommends factored bearing resistances (q_R) of 4 ksf (service limit) and 2.5 ksf (strength limit) be used during design of the replacement culvert and shallow spread foundations for any associated wingwalls/headwalls.

Due to the anticipated bearing depth of the culvert EMH&T has indicated that temporary shoring will be required during construction of portions of the culvert because of the nearby presence of existing structures, the 3rd Street pavement, sidewalks and existing utilities remaining in place. Where feasible, a partial layback is planned to limit required shoring. S&ME understands from EMH&T that temporary sheet piling will be installed along portions on each side of the new culvert to support the walls of the proposed excavation and where existing features are closest to the excavation, internally braced soldier pile and lagging walls are planned. Because of the proximity of existing pavement, structures, sidewalks, etc., to remain after construction of the new culvert, and to minimize the potential for loss of support in the existing soil beneath these structures, S&ME recommends that the temporary retaining structures be designed to minimize deflection of the shoring system(s). Recommended soil strengths and design parameters based on the soil types encountered at the site are provided in Section 6.3.1 for use by EMH&T.

Seepage or groundwater were generally encountered at depths roughly 8 to 21 feet below the existing ground surface. The long term groundwater table is anticipated to be approximately the same as and vary with the level of water in Ritter's Run.

2.0 Introduction

This project includes the replacement of the approximate 840-foot long existing culvert structure (SFN 7060696) carrying Ritters Run under 3rd Street near downtown Mansfield, Ohio. The project limits extend along 3rd Street from Scott Street to Junction Street at the Norfolk & Southern Railroad right-of-way.

Preliminary plans provided by EMH&T indicate the replacement structure currently being considered will consist of a box culvert structure with a 16-foot span, a 6-foot rise, cast-in-place headwalls and wingwalls at the inlet, and a cast-in-place junction chamber at the end of the project. The new culvert will essentially follow the alignment of the existing culvert, with minimal to no regrading of the existing roadway anticipated. This exploration was performed in general accordance with the current ODOT Specifications for Geotechnical Explorations (SGE), including January 2019 updates.

3.0 Geology and Observations of the Project

3.1 Geology of the Site

The project site is in a previously glaciated portion of the state and within the Killbuck-Glaciated Pittsburgh Plateau physiographic region. This region is characterized by clay to loam glacial till of Wisconsinan age, underlain by Mississippian and Pennsylvanian-age shales, sandstones and conglomerates. Bedrock topography mapping, however, indicates the presence of a relatively deep buried valley beneath this site, with the depth to bedrock roughly 200 or more feet to the east of this site. As such, bedrock was not anticipated to be encountered within the proposed boring depths for this project, however, auger refusal on apparent bedrock was noted at depths between roughly 29 and 36 feet in three of the borings. Additionally, ODNR groundwater resource mapping indicates this site is in an area with high groundwater yields (400 to more than 1,000 gallons per minute) from thick, permeable deposits of sand and gravel within the buried valley. Terraced organic and silt deposits are also known to be present within this valley.

A review of the ODNR "Ohio Karst Areas" map reveals that the site lies in an area not known to contain karst features. A review of the ODNR "Landslides in Ohio" map reveals that the project sites lie in an area of low incidence and low susceptibility to landslides, and the ODNR "Abandoned Underground Mines of Ohio" map indicates these sites lie in areas with no mapped abandoned mines near the area of the project site.

3.2 Site Reconnaissance

A site reconnaissance visit was made by S&ME personnel on June 25, 2019, to observe the existing culvert and project vicinity and to field mark the boring locations. The RIC-3rd St. -0313 structure carries Ritters Run at a depth of approximately 9 feet beneath the paved surface of 3rd Street.

3.3 Historic Information

S&ME searched the on-line ODOT Transportation Information Mapping System (TIMS) records for historic boring information and was not able to locate limited historic boring records at the site. The nearest boring was drilled for the Rocky Fork Bridge approximately ½ mile east of the site. The rear abutment boring was drilled in 1975 to a depth of just over 70 feet. The boring encountered silts, clays, and peats.

4.0 Exploration

4.1 Field Investigation

On July 10, 11, and 23, 2019, S&ME performed six (6) borings designated B-001-0-19 through B-006-0-19 (hereafter referred to as B-001 through B-006) to explore the existing soils in the area of the proposed replacement culvert. The culvert borings were extended to depths of 29.4 to 40 feet below the existing ground surface. The approximate locations of the borings are shown on the Plan of Borings included as Plate 2 of Appendix A. Boring locations were obtained using a handheld GPS unit and these geographic coordinates were submitted to EMHT who provided S&ME with ground surface elevations estimated from project topographic survey data, as well as the stations and offsets of the borings.

The borings were performed using a truck-mounted drilling rig using a 3¼-inch I.D. hollow-stem auger. Disturbed (but representative) soil samples were obtained by lowering a 2-inch O.D. split-barrel sampler to the bottom of the boring and then driving the sampler into the soil with blows from a 140-pound hammer freely falling 30 inches (AASHTO T206 - Standard Penetration Test, SPT). In accordance with the current ODOT *Specifications for Geotechnical Explorations* (*SGE*), the hammer system on the drill rig had been calibrated in accordance with ASTM D4633 to determine the drill rod energy ratio (81.8%).

SPT sampling was performed at 2.5-foot intervals from 8.5 to 30 feet, and at 5-foot intervals in the remainder of the borings until either auger refusal on bedrock was encountered or the planned termination depth of 40 feet was encountered. In the field, experienced S&ME personnel performed the following duties: 1) examined and preserved all recovered samples; 2) prepared a log of each boring; 3) recorded seepage and groundwater observations and measurements; 4) obtained hand penetrometer measurements in soil samples exhibiting cohesion; and, 5) provided liaison between the field work and the Engineers so that any modifications to the exploration program could be expeditiously implemented in the event that unusual or unanticipated conditions were encountered. All recovered samples were transported to the soil laboratory of S&ME for further examination and testing.

4.2 Laboratory Testing

In the laboratory, all soil samples were visually identified and tested for natural moisture content, with liquid/plastic limit determinations and grain-size analyses being performed on selected representative specimens. The results of the laboratory index tests are recorded numerically on individual boring logs.

Based upon the results of the laboratory testing program, the field logs were modified, if necessary, and copies of the laboratory corrected boring logs are submitted as Plates 5 through 15 of Appendix A. Shown on these logs are: descriptions of the soil stratigraphy encountered; depths from which samples were preserved; sampling efforts (blow-counts) required to obtain the specimens in the borings; calculated N_{60} values; laboratory testing results; seepage and groundwater observations made at the time of drilling; and, values of hand-penetrometer measurements made in soil samples exhibiting cohesion. For your reference, hand-penetrometer values are roughly equivalent to the unconfined compressive strength of the cohesive soil samples.

Soil and bedrock samples have been described in general accordance with Sections 602 and 605 of the ODOT *SGE*, with soil samples being classified in general accordance with Section 602. An explanation of the symbols and terms used on the boring logs, definitions of the special adjectives used on the logs, and information pertaining to sampling and identification are presented on Plates 3 and 4 of Appendix A. Group Indices determined from the results of the laboratory testing program are also provided on the boring logs.

5.0 Findings

Please refer to the boring logs included in Appendix A for details of the pavement, soil, bedrock, and groundwater/seepage conditions encountered at the boring locations. Inferences should not be made to the subsurface conditions in the areas between or away from the borings without performance of additional borings or other field verification.

5.1 Existing Pavement Thicknesses and Surficial Materials

The thickness of existing pavement materials encountered in the borings is summarized in Table 5-1. The existing pavement thickness was measured from the boring sidewall.

Table 5-1: Summary of Existing Pavement Thicknesses

Boring Number	Asphalt	Brick
B-001	5½″	8″
B-002	5″	7″
B-003	5″	8″
B-004	5½″	8″
B-005	4½″	6″
B-006	4″	7″

A definitive layer of granular base was not observed beneath the brick layer in any of the borings.

5.2 General Subsurface Conditions

Below the existing pavement materials, the borings generally encountered 8 to 13 feet of existing fill and possible fill which consisted variably of loose to medium-dense COARSE AND FINE SAND (A-3a) or GRAVEL WITH SAND (A-1-b), stiff to hard SANDY SILT (A-4a), and hard SILTY CLAY (A-6b). Beneath the fill, discontinuous deposits of natural soils were encountered, including medium-stiff to very-stiff cohesive SANDY SILT (A-4a), SILT AND CLAY (A-6a), and SILTY CLAY (A-6b), and loose to dense GRAVEL WITH SAND (A-1-b), COARSE AND FINE SAND (A-3a), GRAVEL WITH SAND AND SILT (A-2-4), and SANDY SILT (A-4a).

Borings B-001, B-002, and B-006 were terminated at the depths of 33.7, 36.2, and 29.4 feet, respectively, after encountering refusal on highly to severely weathered, very-weak to weak sandstone bedrock.

It should be noted that during laboratory testing, several samples of soil recovered from Borings B-005-0-19 contained a very-strong hydrocarbon odor.

5.3 Groundwater Observations

During drilling, groundwater and groundwater seepage were initially encountered between the depths of 8.5 and 21 feet below the ground surface. Measurements taken inside the hollow-stem augers at the completion of drilling recorded water having accumulated to depths ranging from 11.8 to 20.7 feet below the ground surface.

All groundwater levels and seepage measurements should be considered as temporary, short-term observations and should not be assumed to be representative of the long-term static groundwater level. Groundwater levels can fluctuate due to seasonal variations in precipitation, construction activities, etc.

6.0 Analyses and Recommendations

6.1 General Discussion

S&ME understands the project includes the replacement of the approximately 840-foot long existing culvert beneath the south side of 3rd Street in Mansfield, Ohio, between Scott Street and the Norfolk Southern Railroad right-of-way. The proposed replacement structure is to be a new 4-sided box culvert with dimensions of 16 feet wide by 6 feet high and constructed along essentially the same alignment as the existing culvert. The inlet and outlet of the culvert are anticipated to be cast-in-place with invert elevations near El. 1160 and El. 1148, respectively, with precast box culvert sections placed between. Based on the results of the borings, it is anticipated that the box culvert will bear in either loose to medium-dense or stiff to very-stiff existing fill (A-1-b, A-4a) or stiff to very-stiff natural soil (A-6b). EMH&T has indicated that temporary sheeting/shoring will be required to support the excavations during culvert construction.

6.2 Box Culvert Foundations

6.2.1 Culvert Foundation Preparation

Based on the preliminary plan information provided for the replacement culvert, the invert of the proposed box culvert ranges from approximate El. 1160 at the inlet to El. 1148 at the outlet. The new culvert is anticipated to follow the same or similar alignment as the existing culvert, with minimal to no regrading of the overlying roadway anticipated. Based on the proposed culvert geometry and information provided by EMH&T, S&ME anticipates that the culvert base and any associated headwall foundations for the culvert will bear in loose to medium-dense GRAVEL WITH SAND (A-1-b) or SANDY SILT (A-4a) or stiff to very-stiff SILTY CLAY (A-6b). It should be noted that a few zones of medium-stiff soil were encountered throughout these borings. Where such zones are encountered at the culvert bearing level, or where the soil at the proposed bearing elevation is disturbed during demolition and removal of the existing culvert, it is recommended that the foundation bearing surface be recompacted, or the weak zones be overexcavated, replaced with structural backfill (Item 703.11). If the excavation is dry, then the backfill may consist of Item 703.11, Type 1 or Type 2. If, however, groundwater is present, S&ME recommends that Item 703.11 Type 3 structural backfill be utilized. S&ME recommends that structural backfill be placed and compacted in accordance with ODOT Item 203.

S&ME also recommends that spread foundations for the proposed culvert inlet/headwall be founded at least 12 inches below any riprap placed for scour protection or in accordance with local frost code requirements, whichever is deeper. It is not within our scope of work to evaluate the scour potential at the site. All the existing foundations should be removed prior to the construction of the planned new culvert foundations.

6.2.2 *Bearing Resistance – Culvert Foundations*

Table 6-1 presents the recommended nominal and factored bearing resistances (q_n and q_R) at the service and strength limit states which should be used for the design of the culvert and the spread foundation for the inlet headwall bearing on the loose to medium-dense granular soils or stiff to very-stiff cohesive soils encountered in the borings.

Table 6-1: Recommended Bearing Resistance (Nominal and Factored) for Spread Footing Design – Service and Strength Limit States

Foundation Type	Proposed Bearing Elevation (ft)	Limit State	Nominal Bearing Resistance, q_n (ksf)	Resistance Factor, φ_b	Factored Bearing Resistance, q_R (ksf)
Box Culvert	~1159.0 to ~1146.8 *	Service	--	--	4**
		Strength	5.1	0.5	2.5

* Accounting for a 12-inch thick box culvert below inlet/outlet invert elevations.

** Presumptive Bearing Values from Table C10.6.2.6.1-1 of AASHTO LRFD Bridge Design Specifications

If stiff or weaker soil are present at or just below the proposed bottom of foundation elevation, the material should be over-excavated and the foundation lowered to bear on suitable soils, or the over-excavation below the planned foundation bearing elevation be backfilled as described in Section 6.2.1 and the current ODOT *CMS*. S&ME also recommends that sufficient longitudinal reinforcing steel be provided to strengthen continuous headwall footings against any abrupt differential settlements.

It is recommended that any water flowing in Ritters Runn should be diverted away from the foundation excavation area during excavation and construction of the culvert and associated wing wall foundations. The foundation bearing surfaces should be kept dry and free from standing water during all construction activities. The cohesive soils encountered at the approximate bearing elevation can become weak and compressible when exposed to water. If the foundation materials become wet or loose, additional excavation may be necessary prior to placing foundation concrete. Sumps may be required to pump water accumulations (seepage) from the foundation excavations since the foundations will extend below the level of any possible water in the stream.

6.2.3 *Sliding Resistance – Inlet Headwall*

Sliding resistance to lateral loads is provided by the weight of the structure in combination with the friction developed along the bottom of the foundations at the footing/soil interface as well as from passive resistance from the surrounding soil. The factored resistance against failure by sliding (R_R) should be determined using Eq. 10.6.3.4-1 of the AASHTO LRFD Bridge Design Specifications.

Provided that the headwall foundations are constructed neat and bear directly on the cohesive soils, we recommend a nominal sliding resistance (R_τ) value of 2,500 psf. This recommendation considers that any unsuitable soils encountered at bearing level are overexcavated and replaced with compacted cohesive soil. The factored sliding resistance (R_R) for precast or cast-in-place spread foundations should then be calculated using a resistance factor (ϕ_τ) of 0.85 and the factored sliding resistance (R_R) would be 2,125 psf.

Because Boring B-001 is not located exactly at the inlet headwall location and there is a change of soil type just above the anticipated headwall bearing elevation, EMH&T may want to consider calculating the sliding beneath the inlet headwall supported on a cast-in-place shallow spread foundation using a factored sliding resistance equal to the lesser of either 2,125 psf, or 0.53 times the total vertical foundation load. This approach would accommodate either material type encountered in Boring B-001.

6.2.4 *Eccentricity (Overturning)*

Proposed spread foundations for the culvert and headwall structures which are subjected to eccentric loadings should be designed to account for such loading. For reference, Articles 10.6.1.3, 10.6.3.3 and 11.6.3.3 of the AASHTO *LRFD* provide guidance on designing for eccentric loading. Once the footing design has been finalized, it is recommended that the structural designer confirm that the eccentricity of the foundation is less than one-third (1/3) of the appropriate footing dimension (width and/or length) for footings on soil (AASHTO Article 10.6.3.3).

6.2.5 *Settlement - Culvert*

Since minimal changes to the roadway profile, culvert alignment, bearing depth, and width are anticipated, and provided the culvert foundation is prepared in accordance with Section 6.2.1 of this report, S&ME anticipates that settlement beneath the proposed culvert will be less than 1 inch.

6.2.6 *Scour Countermeasures - Culvert*

It is recommended that the base of the culvert and any wingwall foundations be protected from erosion of soil by scour during periods of elevated flow. It is recommended that below-grade cutoff walls be installed at the inlet of the culvert to at least the anticipated scour depth so that stream flow does not pass beneath, and result in the loss of support by piping, of the base of the culvert. If rock channel protection (rip rap) is to be utilized, it is recommended that foundations be protected from the flow during the design event using, as a minimum, rip rap of a size and layer thickness in accordance with Section 203.3, "Scour", of the ODOT *Bridge Design Manual* (*BDM*). The rip rap should be placed across the entire channel bottom. Additionally, rip rap should be placed in a continuous manner so that no portions of the foundations or creek banks below the design storm water surface are exposed to elevated water flow.

Rip rap is not a permanent or absolute countermeasure against, nor does it totally eliminate, the potential for scour. Therefore, specifications which include the use of rip rap must also contain provisions for routine maintenance of the rip rap blanket so that the design blanket thickness is preserved over the design life of the structure. Additionally, in all cases where rip rap is used for scour control, the structure should be monitored during and inspected after periods of high flow.

6.3 Temporary Shoring

S&ME understands from EMH&T that a combination of slope layback, soldier piles with lagging, and temporary sheet piling is being preliminarily considered for installation just outside the proposed culvert to retain the existing soils during culvert installation. To reduce the potential for damage to existing structures, pavements, sidewalks, and utilities which are immediately adjacent to the planned culvert excavation, S&ME recommends that the temporary shoring system(s) be designed to minimize deflection of the shoring system(s) as a result of the lateral load from the retained soils If movement of the shoring system and retained soil toward the trench is allowed to occur, it may result in settlement, loss of support beneath, and potential damage to, any existing structures, pavements, or utilities adjacent to the excavation. For this reason, we recommend consideration be given to requiring a preconstruction condition assessment of all structures, pavements, sidewalks and utilities within 2 times the shoring height of the back of the shoring. Where slope layback is planned, S&ME also recommends exposed soil on the slope be protected from moisture content fluctuation in the soils.

S&ME understands that the proposed shoring will be less than 8 feet in height and that the Contractor will be responsible for the means, methods, and design of the shoring system(s) utilized during construction. Preliminary information from EMH&T indicates that shoring will be installed along portions of both sides of the existing culvert allowing for the replacement of culvert segments between the shoring. As such, it may be possible to for the shoring to be installed and removed progressively, as each phase of culvert is installed and backfilled, so that shoring of the entire culvert length is not required at any given time.

S&ME's scope of work for this project is to provide geotechnical soil parameters needed for others to develop preliminary and final design of temporary shoring on this project. Our scope of work does not include design of or design review of temporary shoring.

6.3.1 Lateral Earth Pressures – Temporary Shoring

Because of the discontinuous stratigraphy and soil conditions encountered in the borings along the length of the propose culvert, Tables 6-2 through 6-7 present recommendations for LPile p-y soil model names, along with recommended soil unit weights and undrained strengths/effective friction angles representative of the soil conditions encountered in each boring. These recommendations are for use by others during design of the temporary sheeting at this site. As previously discussed in Section 6.3, S&ME recommends the shoring system(s) be designed to minimize deflection, which reduces the potential for settlement or loss of support beneath, and potential damage to, any existing structures, pavements, or utilities behind the temporary shoring. For short-term temporary conditions, the effective friction angle of cohesive soils is commonly considered to be 0°.

Table 6-2: LPile 2019 Input Parameters - Boring B-001

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term φ′ / c	Long Term φ′
A-4a	1166.4 – 1163.5	0 – 4 ft	Soft Clay	115 pcf	1,200 psf	25°
A-1-b	1163.5 – 1156.5	4 – 11 ft	Reese Sand	120 pcf	33°	33°
A-4a	1156.5 – 1149.5	11 – 18 ft	Stiff Clay w/o free water	63 pcf	3,000 psf	30°
A-4a/A-6a	1149.5 – 1144.5	18 – 23 ft	Soft Clay	53 pcf	1,000 psf	28°
A-3a	1144.5 – 1140.1	23 – 27.4 ft	Reese Sand	58 pcf	35°	35°

Table 6-3: LPile 2019 Input Parameters - Boring B-002

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term φ′ / c	Long Term φ′
A-6b	1164.3 – 1154.3	0 – 11 ft	Stiff Clay w/o free water	125 pcf	2,500 psf	28°
A-4a/A-6b	1154.3 – 1152.3	11 – 13 ft	Stiff Clay w/o free water	125 pcf	1,500 psf	26°
A-1-b/A-2-4	1152.3 – 1147.3	13 – 18 ft	Reese Sand	58 pcf	34°	34°
A-6b/A-4a	1147.3 – 1136.2	18 – 29.1 ft	Stiff Clay w/o free water	58 pcf	1,500 psf	28°
A-3a	1136.2 – 1134.3	29.1 – 31 ft	Reese Sand	58 pcf	35°	35°

Table 6-4: LPile 2019 Input Parameters - Boring B-003

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term φ′ / c	Long Term φ′
A-4a	1162.0 – 1159.1	0 – 4 ft	Soft Clay	115 pcf	1,500 psf	26°
A-1-b	1159.1 – 1155.1	4 – 8 ft	Reese Sand	120 pcf	33°	33°
A-4a	1156.1 – 1152.6	8 – 10.5 ft	Soft Clay	120 pcf	1,500 psf	26°
A-4a/A-3a	1152.6 – 1145.1	10.5 – 18 ft	Reese Sand	58 pcf	34°	34°
A-6a	1145.1 – 1142.1	18 – 21 ft	Stiff Clay w/o free water	58 pcf	3,000 psf	28°
A-3a/A-1-b	1142.1 – 1125.1	21 – 38 ft	Reese Sand	58 pcf	34°	34°
A-4a	1125.1 – 1123.1	38 – 40 ft	Stiff Clay w/o free water	58 pcf	2,000 psf	28°

Table 6-5: LPile 2019 Input Parameters - Boring B-004

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term ϕ′ / c	Long Term ϕ′
A-3a/A-1-b	1160.2 – 1153.3	0 – 8 ft	Reese Sand	120 pcf	34°	34°
A-6b	1153.3 – 1149.8	8 – 11.5 ft	Stiff Clay w/o free water	120 pcf	2,000 psf	28°
A-1-b	1149.8 – 1143.8	11.5 – 18 ft	Reese Sand	63 pcf	34°	34°
A-6a	1143.3 – 1140.3	18 – 21 ft	Stiff Clay w/o free water	58 pcf	3,000 psf	28°
A-1-b/A-2-4	1140.3 – 1133.3	21 – 28 ft	Reese Sand	63 pcf	35°	35°
A-6a	1133.3 – 1128.3	28 – 33 ft	Soft Clay	58 pcf	1,500 psf	26°
A-1-b	1128.3 – 1122.4	33 – 38.9 ft	Reese Sand	63 pcf	36°	36°

Table 6-6: LPile 2019 Input Parameters - Boring B-005

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term ϕ′ / c	Long Term ϕ′
A-3a	1158.1 – 1155.0	0 – 4 ft	Reese Sand	120 pcf	34°	34°
A-4a	1155.0 – 1146.0	4 – 13 ft	Soft Clay	115 pcf	1,000 psf	25°
A-6a/A-4a	1146.0 – 1137.7	13 – 21.3 ft	Stiff Clay w/o free water	58 pcf	2,000 psf	28°
A-3a/A-4a	1137.7 – 1133.0	21.3 – 26 ft	Reese Sand	58 pcf	34°	34°
A-6a	1133.0 – 1126.0	26 – 33 ft	Stiff Clay w/o free water	58 pcf	1,700 psf	26°
A-3a	1126.0 – 1121.0	33 – 38 ft	Reese Sand	58 pcf	35°	35°
A-6b	1121.0 – 1119.0	38 – 40 ft	Stiff Clay w/o free water	58 pcf	3,000 psf	28°

Table 6-7: LPile 2019 Input Parameters - Boring B-006

Stratum	Elevation Range	Depth Interval	p-y Model	Effective Unit Weight	Short Term ϕ′ / c	Long Term ϕ′
A-4a	1156.2 – 1153.1	0 – 4 ft	Soft Clay	115 pcf	1,000 psf	25°
A-4a/A-6b	1153.1 – 1144.1	4 – 13 ft	Stiff Clay w/o free water	120 pcf	2,500 psf	28°
A-6a	1144.1 – 1139.1	13 – 18 ft	Soft Clay	58 pcf	1,000 psf	25°
A-1-b	1139.1 – 1134.1	18 – 23 ft	Reese Sand	58 pcf	35°	35°
A-1-b	1134.1 – 1129.1	23 – 28 ft	Reese Sand	63 pcf	36°	36°

6.3.2 *Trench/Shoring Excavation Backfill Recommendations*

If a coarse aggregate or select granular backfill (ODOT *CMS* Item 703.11) is planned to be used to backfill the fully braced excavation above the new culvert, it should be anticipated that some of the existing soil adjacent to the culvert excavation will migrate into the voids in the coarse aggregate once the temporary trench bracing or retaining structure is removed. Migration of soil particles into the voids of the coarse aggregate would also be exacerbated by vibrations from the compaction equipment and from the extraction of the temporary bracing/sheeting as the backfilling proceeds vertically.

This migration of soil could result in subsidence, settlement of or damage to existing structures in the vicinity of the culvert, distress to the new culvert itself, or instability of/distress to the adjacent roadway embankment. To reduce the potential for these issues, S&ME recommends that the entire culvert excavation inside the temporary shoring/bracing be lined with a geotextile fabric (ODOT *CMS* Item 712.09, Type A, Soil Type 2) prior to placement of any granular bedding, culvert section, or select backfill material.

Alternatively, the existing natural soil removed during excavation may be used to backfill the culvert excavation; however, this would require that the culvert be designed using an undrained, at-rest earth pressure condition with an equivalent fluid unit weight of 105 pcf. S&ME believes that the filter fabric would then only be required to wrap any coarse bedding stone placed beneath or around the culvert (Item 611.06), or any zones of select granular material used to backfill where unsuitable soil was over-excavated beneath the planned culvert invert elevation. All fill placed in the culvert trench excavation should be placed and compacted in accordance with ODOT Item 611.06, and Item 203.

6.3.3 *Lateral Earth Pressures – Inlet Wingwalls*

The proposed wingwalls at the culvert inlet must also be designed to withstand lateral earth pressures as well as hydrostatic pressures that may develop behind the structure. The magnitude of the lateral earth pressure varies depending on soil type, permissible wall movement, and the configuration of the backfill.

To minimize lateral earth pressures, the zone behind the inlet wingwalls should be backfilled with granular soil, and the backfill should be effectively drained. For effective drainage, a zone of free-draining gravel (*CMS* Item 518.03) should be used directly behind the structure for a minimum thickness of 24 inches in accordance with ODOT *CMS* Item 518.05. This granular zone should drain to either weepholes or a pipe, so that hydrostatic pressures do not develop against the walls.

The type of backfill beyond the free-draining granular zone will govern the magnitude of the pressure to be used for structural design. To minimize the pressure acting on the wingwalls, it is recommended that granular backfill be placed in a wedge formed by the back of the wingwall and a line rising from the base of the wingwall foundation at an angle no greater than 60 degrees from the horizontal. Granular backfill behind the wingwalls should be compacted in accordance with *CMS* Item 203. Over-compaction in areas directly behind the wingwalls should be avoided as this might cause damage to the walls.

For wingwalls, provided wall movement greater than 0.25 percent the height of the wall (H) occurs, an "active" earth pressure condition may be utilized. If proper drainage is incorporated and the granular backfill is placed and compacted in the wedge described previously, an equivalent fluid unit weight of 35 pcf may be used. Without the required movement, but with proper drainage and the wedge of granular backfill is placed and compacted as described previously, an equivalent fluid unit weight of 55 pounds per cubic foot (pcf) may be used assuming an "at rest" earth pressure condition.

Compacted cohesive materials tend alternatively to shrink, expand and creep over periods of time and create significant lateral pressures on any adjacent structures. Cohesive materials also require a greater amount of movement to mobilize an active earth pressure condition. To mobilize the active earth pressure condition in cohesive materials, wall movement 1.0 percent of the height of the wall (H) must occur. Because of the long-term adverse effects, it is recommended that, if proper drainage (*CMS* Item 518.03) is provided, equivalent fluid unit weights of 65 pcf (active) and 90 pcf (at-rest) may be used. Without proper drainage, S&ME recommends that the structural design be performed using equivalent fluid unit weights of 95 pcf (active) and 105 pcf (at-rest).

6.4 Groundwater Considerations for Culvert Construction

During this exploration, seepage or groundwater was encountered at depths of roughly 8 to 21 feet below the existing ground surface. It is anticipated the long term groundwater level in the immediate vicinity of the proposed culvert will be approximately the same as, and vary with, the level of water in Ritter's Run.

The surface water and groundwater should be controlled during construction, as the cohesive soil that will likely be present at and just below portions of the proposed foundation level will typically exhibit instability in the presence of water and construction vibrations. S&ME recommends that the sides and bottoms of all excavations be closely monitored during the construction of the structure. If the soils at the bottom of an excavation become disturbed by construction activity or channel flow, it is recommended that the disturbed material be undercut and replaced or be removed and the footing elevation be lowered to more suitable bearing soils.

It is recommended that all excavations for the proposed structure foundations be protected from stream, groundwater, and storm water flow. Even with stream flow diversion, provisions for pumping from sumps should be made for the expected larger groundwater flows that may be encountered in excavations extending below the level of water in the stream.

Some water seepage may also emanate from any granular seams or zones that are encountered in excavations performed above the level of water in the stream; however, the quantity of water is anticipated to be limited and may likely be controlled by bailing or with portable pumps.

6.5 Temporary Excavation Considerations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P". This document was issued to better ensure the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations be constructed in accordance with the OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. If an excavation, including a trench is extended to a depth of more than twenty (20) feet, it will be necessary to have the side slopes designed by a professional engineer registered in the state where the construction is occurring.

We are providing this information solely as a service to our client. S&ME does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

7.0 Final Considerations and Report Limitations

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

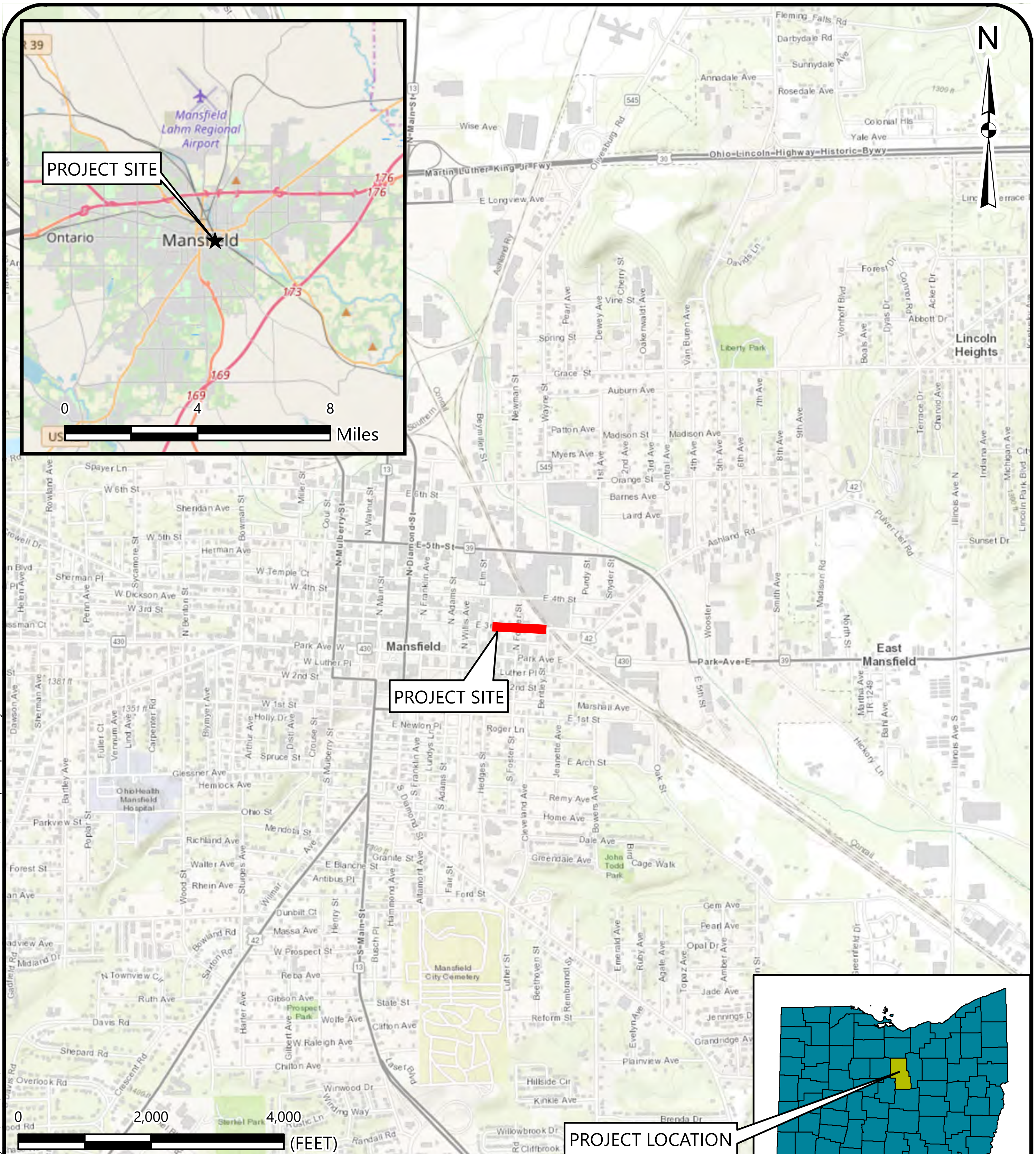
Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and monitoring of earthwork and foundation construction activities.

Appendices

Appendix A



REFERENCE/NOTES:
GIS BASE LAYERS WERE OBTAINED FROM USGS *THE NATIONAL MAP* AND *OPENSTREETMAP* ©. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED, THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Drawing Path: T:\Projects\2019\GEO\1117-19-038 EMH&T - RIC-3rd St-0313 Culvert\GIS\V-Map.mxd plotted by cwest 12-20-2019

VICINITY MAP

RIC-3RD STREET-0313
RITTERS RUN CULVERT REPLACEMENT
MANSFIELD, RICHLAND COUNTY, OHIO

SCALE:	PLATE No.
1 " = 2,000 '	1
DATE: 12-20-19	
PROJECT NUMBER 1117-19-038	

AERIAL IMAGERY OBTAINED FROM THE OHIO GEOGRAPHICALLY REFERENCED INFORMATION PROGRAM'S (OGRIPS) *2013 OHIO STATE WIDE IMAGERY PROGRAM (OSIP II)* THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED, THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

LEGEND

APPROXIMATE BORING LOCATIONS

PLAN OF BORINGS

RIC-3RD STREET-0313
RITTERS RUN CULVERT REPLACEMENT
MANSFIELD, RICHLAND COUNTY, OHIO

SCALE:
1 " = 60 '

DATE:
12-20-19

PROJECT NUMBER
1117-19-038

PLATE NO.
2

Drawing Path: T:\Projects\2019\GEO\1117-19-038 EMH&T- RIC-3rd St-0313 Culvert\GIS\POB.mxd plotted by cwest 12-20-2019

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF SOIL

SAMPLING DATA

▮	-	Indicates sample was attempted within this depth interval.
2 3 5	-	The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches (SPT). The raw "blowcount" or "N" is equal to the sum of the second and third 6-inch increments of penetration.
N_{60}	-	Corrected Blowcount = [(Drill Rod Energy Ratio) / (0.60 Standard)] X N
SS	-	Split-barrel sampler, any size.
ST	-	Shelby tube sampler, 3″ O.D., hydraulically pushed.
R	-	Refusal of sampler in very-hard or dense soil, or on a resistant surface.
50-0.3′	-	Number of blows (50) to drive a split-barrel sampler a certain distance (0.3 feet), other than the normal 6-inch increment.

DEPTH DATA

W	-	Depth of water or seepage encountered during drilling.
▼ AD	-	Depth to water in boring after drilling (AD) is terminated.
▼ 5 days	-	Depth to water in monitoring well or piezometer in boring a certain number of days (5) after termination of drilling.
TR	-	Depth to top of rock.

SOIL DESCRIPTIONS

Soils have been classified in general accordance with Section 603 of the most recent ODOT SGE, and described in general accordance with Section 602, including the use of special adjectives to designate approximate percentages of minor components as follows:

Adjective	Percent by Weight
trace	1 to 10
little	10 to 20
some	20 to 35
"and"	35 to 50

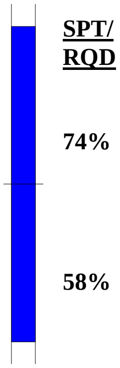
The following terms are used to describe density and consistency of soils:

Term (Granular Soils)	Blows per foot (N_{60})
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50

Term (Cohesive Soils)	Qu (tsf)
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF ROCK

SAMPLING DATA



When bedrock is encountered and rock core samples are attempted, the length of core recovered and lost during the core run is reported in the "REC" column. The type of rock core barrel utilized is recorded under the heading "Sampling Method" at the top of the boring log, and also in the "SAMPLE ID" column. Rock-core barrels can be of either single- or double-tube construction, and a special series of double-tube barrels, designated by the suffix M, may also be used to obtain maximum core recovery in very-soft or fractured rock. Four basic groups of barrels are used most often in subsurface investigations for engineering purposes, and these groups and the diameters of the cores obtained are as follows:

AX, AW, AXM, AWM	-	1-1/8 inches
BX, BW, BXM, BWM	-	1-5/8 inches
NX, NW, NXM, NWM	-	2-1/8 inches
NQ, NQ2	-	1-7/8 inches

Rock Quality Designation (RQD) is expressed as a percentage and is obtained by summing the total length of all core pieces which are at least 4 inches long and then dividing this sum by, either, the total length of core run or the length of the core run in a particular bedrock stratum. The RQD value is reported as a percentage in the "SPT/RQD" column. It has been found that there is a reasonably good relationship between the RQD value and the general quality of rock for engineering purposes. This relationship is shown as follows:

RQD - %	General Quality
0 - 25	Very-poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK HARDNESS

Recovered bedrock samples are described in general accordance with Section 605 of the latest ODOT SGE and subsequent revisions, where necessary. The following terms are used to describe rock hardness:

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

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313 TYPE: CULVERT REPLACEMENT PID: BR ID: RIC-3RDS-00313 START: 7/10/19 END: 7/10/19	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN SAMPLING FIRM / LOGGER: S&ME / D. GODWIN DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: S&ME TRK 55 HAMMER: SAFETY HAMMER CALIBRATION DATE: 12/13/17 ENERGY RATIO (%): 81.8	STATION / OFFSET: 10+81, 14' LT ALIGNMENT: CL CULVERT ELEVATION: 1167.5 (MSL) EOB: 33.7 ft. COORD: 40.759541 N, 82.509430 W

EXPLORATION ID **B-001-0-19**

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1167.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 5-1/2 INCHES	1167.1																	
BRICK - 8 INCHES	1166.4	1																
Fill: Stiff to very-stiff brown **SANDY SILT**, little clay, little fine to coarse gravel, moist.		2–3	4 2 2	5	39	SS-1	1.2-3.0	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1163.5	4																
Probable Fill: Loose to medium-dense brown **GRAVEL WITH SAND**, little silt, trace clay, few cobbles, contains iron oxide stains, damp.		5	2 2 3	7	56	SS-2	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		6–8 (W 1159.0)																
		9–10	2 3 5	11	33	SS-3	-	47	18	16	12	7	-	-	-	15	A-1-b (V)	
	1156.5																	
Very-stiff to hard gray **SANDY SILT**, little to some clay, trace to little fine to coarse gravel, few cobbles, damp.		11–12	2 3 7	14	33	SS-4	3.0-4.0	-	-	-	-	-	-	-	-	13	A-4a (V)	
		13 (W 1154.0)																
		14–15	2 7 15	30	39	SS-5	3.0-4.2	19	9	19	32	21	20	14	6	10	A-4a (4)	
		16–17	5 10 11	29	100	SS-6	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
	1149.5	18																
Stiff to very-stiff gray **SANDY SILT**, some clay, little fine to coarse gravel, damp to moist.		19–20	3 4 6	14	56	SS-7	1.0-2.5	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1146.0	21	1 2 3	7	39	SS-8A	1.0-1.2	13	12	18	35	22	21	14	7	14	A-4a (4)	
Stiff gray and brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, moist to wet.		22				SS-8B	1.0-1.5	-	-	-	-	-	-	-	-	16	A-6a (V)	
	1144.5	23																
Dense to very-dense brown **COARSE AND FINE SAND**, little fine to coarse gravel, trace silt, trace clay, wet.		24–25	11 27 21	65	50	SS-9	-	19	6	61	8	6	-	-	-	19	A-3a (V)	
		26–27	18 9 50-5"	-	71	SS-10	-	-	-	-	-	-	-	-	-	18	A-3a (V)	
	1140.1	TR																
SANDSTONE, brown, highly to severely weathered, very weak to weak, highly fractured, partly similar to very-dense gravel.		28–29	50-4"	-	75	SS-11	-	-	-	-	-	-	-	-	-	17	Rock (V)	

PID:	BR ID: RIC-3RDS-00313	PROJECT: RIC-3RD STREET-0313	STATION / OFFSET: 10+81, 14' LT	START: 7/10/19	END: 7/10/19	PG 2 OF 2	B-001-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 1137.5	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
SANDSTONE, brown, highly to severely weathered, very weak to weak, highly fractured, partly similar to very-dense gravel. *(continued)*	1133.8	31 32 33 EOB	50-3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	16	Rock (V)	

- Seepage noted at 8.5'.
- Water noted at 13.5'.
- Cobbles noted at 10.5' and 15.0'.
- Auger refusal encountered at 33.7'.
- At completion, water measured at 20.7' inside HSA.
- Boring caved at 24.2' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 12+31, 15' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1165.3 (MSL) EOB: 36.2 ft.
START: 7/10/19 END: 7/10/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759522 N, 82.508889 W

EXPLORATION ID: **B-002-0-19**

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1165.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 5 INCHES	1164.9																	
BRICK - 7 INCHES	1164.3																	
Fill: Very-stiff to hard brown and dark-brown **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp to moist.	1161.3	2–3	3 4 6	14	100	SS-1	2.5-4.5	-	-	-	-	-	-	-	-	16	A-6b (V)	
Possible Fill: Hard brown mottled with gray **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp to moist.	1157.3	4–5.5	5 4 7	15	61	SS-2	4.5+	1	2	16	27	54	37	18	19	17	A-6b (12)	
Very-stiff dark-brown **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp.	1154.3	8.5–10	4 5 7	16	33	SS-3	2.2-2.7	-	-	-	-	-	-	-	-	15	A-6b (V)	
Stiff to very-stiff gray **SANDY SILT**, some clay, trace fine to coarse gravel, damp.	1153.5	11–12.5	2 3 7	14	72	SS-4A	1.5-2.5	7	6	18	36	33	25	16	9	15	A-4a (7)	
Stiff to very-stiff brown **SILTY CLAY**, some fine to coarse sand, little fine to coarse gravel, contains silt seams, damp to moist.	1152.3	W 1151.8				SS-4B	1.7-2.5	-	-	-	-	-	-	-	-	18	A-6b (V)	
Medium-dense brown **GRAVEL WITH SAND**, little silt, trace clay, moist.	1149.3	13.5–15	4 5 8	18	56	SS-5	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
Medium-dense brown **GRAVEL WITH SAND AND SILT**, trace clay, damp.	1147.3	16–17.5	4 6 6	16	61	SS-6	-	29	15	24	24	8	-	-	-	15	A-2-4 (V)	
Stiff to very-stiff gray and brown **SILT AND CLAY**, little fine to coarse sand, trace to little fine to coarse gravel, damp.		18.5–20	2 3 5	11	33	SS-7	2.0-2.5	-	-	-	-	-	-	-	-	15	A-6a (V)	
	1142.3	21–22.5	2 3 4	10	39	SS-8	1.2-3.0	-	-	-	-	-	-	-	-	14	A-6a (V)	
Stiff gray **SANDY SILT**, some fine to coarse sand, little fine to coarse gravel, damp.	1139.3	23.5–25	3 3 4	10	33	SS-9	1.0-1.5	18	9	18	29	26	23	14	9	15	A-4a (4)	
Very-stiff to hard gray **SILT AND CLAY**, little fine to coarse sand, trace fine to coarse gravel, contains silt lenses, damp.	1136.2	26–27.5	4 8 10	25	100	SS-10	2.2-3.5	-	-	-	-	-	-	-	-	14	A-6a (V)	
		28.5–30	5 11 18	40	67	SS-11A	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	
SEE NEXT SHEET						SS-11B	-	-	-	-	-	-	-	-	-	11	A-3a (V)	

PID:	BR ID: RIC-3RDS-00313	PROJECT: RIC-3RD STREET-0313	STATION / OFFSET: 12+31, 15' LT	START: 7/10/19	END: 7/10/19	PG 2 OF 2	B-002-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 1135.3	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 brown **COARSE AND FINE SAND**, little fine gravel, little clayey silt. *(continued)*	1134.3	TR 31																
SANDSTONE, brown, highly to severely weathered, very-weak to weak, fractured.		32 33																
		34	50-1"	-	0	--	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1129.1	35 EOB 36																

- Water noted at 13.5'.
- Auger refusal encountered at 36.2'.
- At completion, water measured at 12.4' inside HSA.
- Boring caved at 27.4' after augers removed.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313 TYPE: CULVERT REPLACEMENT PID: BR ID: RIC-3RDS-00313 START: 7/11/19 END: 7/11/19	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN SAMPLING FIRM / LOGGER: S&ME / D. GODWIN DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: S&ME TRK 55 HAMMER: SAFETY HAMMER CALIBRATION DATE: 12/13/17 ENERGY RATIO (%): 81.8	STATION / OFFSET: 13+79, 16' LT ALIGNMENT: CL CULVERT ELEVATION: 1163.1 (MSL) EOB: 40.0 ft. COORD: 40.759504 N, 82.508353 W

EXPLORATION ID: **B-003-0-19**
PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1163.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 5 INCHES	1162.7																	
BRICK - 8 INCHES	1162.0																	
Fill: Stiff to very-stiff brown and gray **SANDY SILT**, some clay, trace fine to coarse gravel, damp to moist.	1159.1	1–3	5 5 6	15	72	SS-1	1.0-3.5	-	-	-	-	-	-	-	-	15	A-4a (V)	
Fill: Loose brown **GRAVEL WITH SAND**, trace silt, trace clay, damp to moist.	1155.1	4–8	4 1 5	8	50	SS-2	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
Possible Fill: Stiff to very-stiff brown and gray **SANDY SILT**, little clay, trace fine to coarse gravel, damp.	1152.6	9–10	5 3 3	8	61	SS-3	1.2-2.7	-	-	-	-	-	-	-	-	14	A-4a (V)	
Loose brown **SANDY SILT**, little clay, trace fine to coarse gravel, moist.	1150.1	W 1152.1; 11–12	2 3 2	7	100	SS-4	-	-	-	-	-	-	-	-	-	21	A-4a (V)	
Loose to medium-dense brown **COARSE AND FINE SAND**, trace to little clay, trace to little silt, little to some fine to coarse gravel, damp.		13–15	2 2 5	10	72	SS-5	-	19	19	32	18	12	NP	NP	NP	15	A-3a (0)	
	1145.1	16–18	4 7 7	19	61	SS-6	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
Very-stiff to hard gray **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, damp to moist.	1142.1	19–20; W 1142.1	4 5 5	14	67	SS-7	3.5-4.5	-	-	-	-	-	-	-	-	14	A-6a (V)	
Medium-dense gray **COARSE AND FINE SAND**, little fine to coarse gravel, little silt, little clay, wet.	1140.1	21–22	2 5 5	14	56	SS-8	-	13	29	23	20	15	17	12	5	15	A-3a (0)	
Medium-dense brown **GRAVEL WITH SAND**, trace silt, trace clay, wet.		23–24	2 4 5	12	0	--	-	-	-	-	-	-	-	-	-	-		
	1137.1	25	6	-	100	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
Medium-dense gray **GRAVEL WITH SAND**, little silt, trace clay, wet.		26–27	3 4 6	14	33	SS-10	-	30	27	24	11	8	-	-	-	15	A-1-b (V)	
		28–29	5 8 5	18	50	SS-11	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	

S&ME ODOT LOG (8.5X11) - SGE 01/2019 - OH DOT.GDT - 1/22/20 10:46 - S:\RESOURCES\CS\GINTW\PROJECTS\111719038.GPJ

S&ME JOB: 1117-19-038

PID:	BR ID: RIC-3RDS-00313	PROJECT: RIC-3RD STREET-0313	STATION / OFFSET: 13+79, 16' LT	START: 7/11/19	END: 7/11/19	PG 2 OF 2	B-003-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 1133.1	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
Medium-dense gray **GRAVEL WITH SAND**, little silt, trace clay, wet. *(continued)*	1130.1	31–33																
Medium-dense brown **COARSE AND FINE SAND**, some fine to coarse gravel, little silt, trace clay, wet.		34–35	8 6 7	18	39	SS-12	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
	1125.1	36–38																
Stiff to very-stiff gray **SANDY SILT**, little fine to coarse gravel, some clay, wet.	1123.1	39–40 EOB	2 7 14	29	56	SS-13	1.7-3.2	-	-	-	-	-	-	-	-	14	A-4a (V)	

- Seepage noted at 11.0'.
- Water noted at 21.0'.
- At completion, water measured at 16.1' inside HSA.
- Boring caved at 23.2', after augers removed.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313
TYPE: CULVERT REPLACEMENT
PID: ______ BR ID: RIC-3RDS-00313
START: 7/11/19 END: 7/11/19

DRILLING FIRM / OPERATOR: S&ME / D. GODWIN
SAMPLING FIRM / LOGGER: S&ME / D. GODWIN
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: S&ME TRK 55
HAMMER: SAFETY HAMMER
CALIBRATION DATE: 12/13/17
ENERGY RATIO (%): 81.8

STATION / OFFSET: 15+41, 15' LT
ALIGNMENT: CL CULVERT
ELEVATION: 1161.3 (MSL) EOB: 40.0 ft.
COORD: 40.759478 N, 82.507772 W

EXPLORATION ID **B-004-0-19**

MATERIAL DESCRIPTION AND NOTES	ELEV. 1161.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 5-1/2 INCHES	1160.9																	
BRICK - 8 INCHES	1160.2	1																
Fill: Loose brown **COARSE AND FINE SAND**, some fine to coarse gravel, little silt, little clay, damp.	1157.3	2–3	4 3 2	7	56	SS-1	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
Possible Fill: Medium-dense brown **GRAVEL WITH SAND**, trace silt, few sandstone fragments, damp.	1153.3	4–7	8 7 10	23	61	SS-2	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
Very-stiff brown mottled with gray **SILTY CLAY**, some fine to coarse sand, little fine gravel, contains iron oxide stains, moist.	1149.8	8–10	3 3 5	11	61	SS-3	2.0-3.7	11	5	22	29	33	35	17	18	20	A-6b (9)	
Medium-dense to dense brown **GRAVEL WITH SAND**, little silt, trace clay, wet.		11–12	4 16 17	45	0	--	-	-	-	-	-	-	-	-	-	-		
		13 (W 1147.8)	12	-	0	--	-	-	-	-	-	-	-	-	-	-		
		14–15	2 4 5	12	33	SS-5	-	-	-	-	-	-	-	-	-	21	A-1-b (V)	
	1143.3	16–17	2 5 6	15	33	SS-6	-	40	14	26	14	6	-	-	-	15	A-1-b (V)	
Very-stiff brown **SILT AND CLAY**, some fine to coarse sand, trace fine to coarse gravel, damp.		18–19	8 3 4	10	0	--	-	-	-	-	-	-	-	-	-	-		
	1140.3	20	5	-	100	SS-7	3.0-4.0	-	-	-	-	-	-	-	-	14	A-6a (V)	
Medium-dense gray **GRAVEL WITH SAND**, little silt, trace clay, wet.	1138.3	21–22	5 9 12	29	33	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
Medium-dense gray and brown **GRAVEL WITH SAND AND SILT**, little clay, wet.	1135.8	23–25	6 8 8	22	50	SS-9	-	33	19	19	15	14	18	12	6	13	A-2-4 (0)	
Dense brown **GRAVEL WITH SAND**, little silt, trace clay, wet.	1133.3	26–27	12 12 15	37	33	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
Stiff to very-stiff brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, wet.		28–29	15 15 18	45	67	SS-11	1.0-2.7	-	-	-	-	-	-	-	-	15	A-6a (V)	

PID:	BR ID: RIC-3RDS-00313	PROJECT: RIC-3RD STREET-0313	STATION / OFFSET: 15+41, 15' LT	START: 7/11/19	END: 7/11/19	PG 2 OF 2	B-004-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 1131.3	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
Stiff to very-stiff brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, wet. *(continued)*	1128.3	31, 32, 33																
Dense gray **GRAVEL WITH SAND**, trace silt, trace clay, wet.		34, 35	12 16 18	46	50	SS-12	-	20	40	28	6	6	-	-	-	19	A-1-b (V)	
	1123.3	36, 37, 38																
Medium-dense brown **GRAVEL WITH SAND**, little silt, wet.	1122.4	39	7 9 12	29	56	SS-13A	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
Very-stiff to hard gray **SANDY SILT**, little fine to coarse gravel, some clay, damp.	1121.3	EOB 40				SS-13B	3.2-4.5	-	-	-	-	-	-	-	-	12	A-4a (V)	

- Water noted at 13.5'.
- At completion, water measured at 19.2' inside HSA.
- Boring caved at 22.3' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313 TYPE: CULVERT REPLACEMENT PID: ____ BR ID: RIC-3RDS-00313 START: 7/23/09 END: 7/23/19	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN SAMPLING FIRM / LOGGER: S&ME / D. GODWIN DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: S&ME TRK 55 HAMMER: SAFETY HAMMER CALIBRATION DATE: 12/13/17 ENERGY RATIO (%): 81.8	STATION / OFFSET: 16+90, 15' LT ALIGNMENT: CL CULVERT ELEVATION: 1159.0 (MSL) EOB: 40.0 ft. COORD: 40.759458 N, 82.507234 W

EXPLORATION ID **B-005-0-19**

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1159.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 4-1/2 INCHES	1158.7																	
BRICK - 6 INCHES	1158.1	1																
Fill: Medium-dense brown **COARSE AND FINE SAND**, little fine to coarse gravel, little silt, little clay, moist.	1155.0	2–3	10 5 3	11	50	SS-1	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
Fill: Medium-stiff to stiff brown and gray **SANDY SILT**, little to some clay, trace fine to coarse gravel, very-strong hydrocarbon odor, moist.		4–6	1 2 1	4	33	SS-2	1.0	9	7	35	30	19	23	15	8	20	A-4a (3)	
		7–10	1 3 4	10	61	SS-3	1.0-2.0	-	-	-	-	-	-	-	-	-	A-4a (V)	
	1146.0	11–12	1 2 3	7	33	SS-4	0.7-1.2	-	-	-	-	-	-	-	-	-	A-4a (V)	
Stiff to very-stiff brown **SILT AND CLAY**, little fine to coarse sand, little fine to coarse gravel, moist.		13–15	3 5 9	19	56	SS-5	3.0-3.7	-	-	-	-	-	-	-	-	15	A-6a (V)	
	1141.0	16–17	3 7 7	19	33	SS-6	1.5-2.5	-	-	-	-	-	-	-	-	15	A-6a (V)	
Very-stiff gray **SANDY SILT**, some clay, trace fine gravel, moist to wet.	1137.7	18–20 (W 1138.0)	3 6 9	20	33	SS-7	3.0-3.5	8	8	18	35	31	25	16	9	13	A-4a (6)	
		21	4 7 11	25	56	SS-8A	2.0-2.2	-	-	-	-	-	-	-	-	24	A-4a (V)	
Medium-dense brown **COARSE AND FINE SAND**, some silt, trace clay, wet.	1136.0	22				SS-8B	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
Very-dense brown **SANDY SILT**, little clay, some fine to coarse gravel, very-strong hydrocarbon odor, wet.	1133.0	23–25	10 14 25	53	33	SS-9	-	24	8	20	30	18	-	-	-	17	A-4a (V)	
Stiff to very-stiff brown and gray **SILT AND CLAY**, little to some fine to coarse sand, trace fine to coarse gravel, moist.		26–27	5 7 8	20	39	SS-10	1.2-3.5	-	-	-	-	-	-	-	-	17	A-6a (V)	
		28–29	3 5 7	16	33	SS-11	1.2-3.0	-	-	-	-	-	-	-	-	21	A-6a (V)	

S&ME JOB: 1117-19-038

PID: ______ | BR ID: RIC-3RDS-00313 | PROJECT: RIC-3RD STREET-0313 | STATION / OFFSET: 16+90, 15' LT | START: 7/23/09 | END: 7/23/19 | PG 2 OF 2 | **B-005-0-19**

MATERIAL DESCRIPTION AND NOTES	ELEV. 1129.0	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
Stiff to very-stiff brown and gray **SILT AND CLAY**, little to some fine to coarse sand, trace fine to coarse gravel, moist. *(continued)*	1126.0	31, 32, 33																
Medium-dense to dense gray and brown **COARSE AND FINE SAND**, trace fine to coarse gravel, little to some silt, trace clay, few cobbles, moist.		34, 35	5 12 16	38	22	SS-12	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
	1121.0	36, 37, 38																
Very-stiff gray **SILTY CLAY**, some fine to coarse sand, trace fine to coarse gravel, damp to moist.	1119.0	39, EOB 40	5 6 8	19	56	SS-13	2.7-3.5	-	-	-	-	-	-	-	-	14	A-6b (V)	

- Water noted at 21.0'.
- Cobbles noted at 33.0'.
- At completion, water measured at 13.4' inside HSA.
- Boring caved at 29.3' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 18+41, 16' LT	EXPLORATION ID **B-006-0-19**
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT	
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1157.1 (MSL) EOB: 29.4 ft.	PAGE 1 OF 1
START: 7/23/19 END: 7/23/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759437 N, 82.506687 W	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1157.1	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
ASPHALT - 4 INCHES	1156.8																	
BRICK - 7 INCHES	1156.2																	
Fill: Stiff to very-stiff brown and dark-brown **SANDY SILT**, some clay, trace fine to coarse gravel, few medium-stiff zones, few brick fragments, damp to moist.		2	12 4 2	8	39	SS-1	0.7-2.5	-	-	-	-	-	-	-	-	21	A-4a (V)	
		5	8 4 3	10	33	SS-2	2.5	-	-	-	-	-	-	-	-	13	A-4a (V)	
	1149.1																	
Very-stiff brown mottled with gray **SILTY CLAY**, trace fine to coarse sand, trace fine gravel, contains silt seams, moist.		9	2 2 3	7	100	SS-3	2.0-2.5	1	2	3	45	49	37	20	17	25	A-6b (11)	
		12	2 3 4	10	100	SS-4	2.5-3.5	-	-	-	-	-	-	-	-	24	A-6b (V)	
	1144.1																	
Stiff brown mottled with gray **SILT AND CLAY**, trace fine to coarse sand, contains silt seams, contains iron oxide filled dessication cracks, moist.		14	2 2 3	7	100	SS-5	1.0-1.7	0	2	3	50	45	32	19	13	25	A-6a (9)	
		17	1 1 2	4	83	SS-6	1.0-1.2	-	-	-	-	-	-	-	-	25	A-6a (V)	
	1139.1																	
Medium-dense brown **GRAVEL WITH SAND**, little silt, trace clay, moist to wet.		19	2 5 7	16	33	SS-7	-	59	13	12	11	5	-	-	-	10	A-1-b (V)	
		W 1136.1 (21)																
		22	4 5 4	12	72	SS-8	-	-	-	-	-	-	-	-	-	20	A-1-b (V)	
	1134.1																	
Dense gray and brown **GRAVEL WITH SAND**, little silt, trace clay, wet.		24	4 21 10	42	56	SS-9	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
		27	18 14 15	40	39	SS-10	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	1129.1	TR (28)																
SANDSTONE, brown, highly to severely weathered, very-weak to weak, highly fractured.	1127.7	29 EOB	40 50-5"	-	55	SS-11	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	

NOTES: WATER NOTED AT 21.0'; ENCOUNTERED AUGER REFUSAL AT 29.4' AND BORING TERMINATED; AT COMPLETION, WATER AT 11.8' INSIDE HSA.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

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Important Information About Your
Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Geotechnical Findings Are Professional Opinions

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project.

Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.

Appendix B

Based on prelim elevations from EMH&T (not final El's) & Prelim P&P from conceptual study for Mansfield, proposed box culvert will bear on:

B-1 Lo-mde A-1-b $N_{60} \to 7\text{-}11$ $\phi \approx 34°$

B-2 St-vst A-6b/A-4a $H = 1.5\text{-}2.7$

B-3 St vst A-4a $H = 1.2\text{-}2.7$
over
Lo br A-4a $N_{60} = 7$ $\phi \approx 28°$ $D_f = 1'$

B-4 Vst A-6b $H = 2.0\text{-}3.7$

B-5 Mst-st A-4a $H = 1.0\text{-}2.0$, $0.7\text{-}1.2$ $H = 1.0$

B-6 Vst A-6b $H = 2.0\text{-}2.5$

Check Bearing of the above

Nominal Bearing

Cohesive $\rightarrow q_n = 1000(5.14) + (\gamma = 150pcf - 62)(D_f = 1)(N_q = 1)(C_{wq} = 0.5) = 5184 psf$

Factored Bearing (Cohesive) $= 0.50(5184 psf) = 2.500 ksf$

Resist. Factor φ_b

Granular $\rightarrow$ Nominal

$$q_n = \cancel{\emptyset} + (\gamma = 0.088 ksf)(D_f = 1)(N_q = 14.7)(C_{wq} = 0.5) + 0.5(\gamma = 0.088)(B = 16')(N_\gamma = 16.7)(C_{w\gamma} = 0.5)$$

$$q_n = 0 + 0.646 + 5.878 \Rightarrow q_n = 6.524 ksf$$

Granular (Factored)

Factored Bearing $\Rightarrow$ Resist Factor $\varphi_b = 0.45 \times 6.524 \Rightarrow 2.936$ ksf

Use Strength State Factored Bearing Resistance = 2.5 ksf

Service Limit = 5100 ksf

Appendix C

II. Reconnaissance and Planning Checklist

C-R-S: RIC-3rd St-0313	PID:	Reviewer: RSW	Date: 12/30/19

Reconnaissance					
Y	N	X	1	Based on Section 302.1 in the SGE, have the necessary plans been developed in the following areas prior to the commencement of the subsurface exploration reconnaissance: □ Roadway plans ■ Structures plans □ Geohazards plans	
Y	N	X	2	Based on Section 302.2 in the SGE, has the Geotechnical Red Flag Summary, or in its absence, the resources listed in Section 202 of the SGE, been reviewed as part of the office reconnaissance?	
Y	N	X	3	Have all the features listed in Section 302.3 of the SGE been observed and evaluated during the field reconnaissance?	
Y	N	X	4	If notable features were discovered in the field reconnaissance, were the GPS coordinates of these features recorded?	

II. Reconnaissance and Planning Checklist

Planning - General					
Y	N	X	5	In planning the geotechnical exploration program for the project, have the specific geologic conditions, the proposed work, and existing subsurface exploration work been considered?	
Y	N	X	6	Have the borings been located to develop the maximum subsurface information while using a minimum number of borings?	
Y	N	X	7	Has the topography, geologic origin of materials, surface manifestation of soil conditions, and any other special design considerations been utilized in determining the spacing and depth of borings?	
Y	N	X	8	Have the borings been located so as to provide adequate overhead clearance for the equipment, clearance of underground utilities, minimize damage to private property, and minimize disruption of traffic, without compromising the quality of the exploration?	
Y	N	X	9	Have any previous geotechnical explorations been utilized to the fullest extent possible?	
Y	N	X	10	Have the scaled boring plans, showing all project and historic borings, and a schedule of borings in tabular format, been submitted to the District Geotechnical Engineer?	Submitted with proposal to Client.
				The schedule of borings should present the following information for each boring:	
Y	N	X		□ exploration identification number	
Y	N	X		□ location by station and offset	
Y	N	X		□ estimated amount of rock and soil, including the total for each for the entire program.	
Planning – Exploration Number					
Y	N	X	11	Have the coordinates, stations and offsets of all explorations (borings, probes, test pits, etc.) been identified?	
Y	N	X	12	Has each exploration been assigned a unique identification number, in the following format X-ZZZ-W-YY, as per Section 303.2 of the SGE?	
Y	N	X	13	When referring to historic explorations that did not use the identification scheme in 12 above, have the historic explorations been assigned identification numbers according to Section 303.2 of the SGE?	

Notes:

II. Reconnaissance and Planning Checklist

Planning – Boring Types		
Y N X 14	Based on Sections 303.3 to 303.76 of the SGE, have the location, depth, and sampling requirements for the following boring types been determined for the project? Check all boring types utilized for this project: □ Existing Subgrades (Type A) □ Roadway Borings (Type B) □ Embankment Foundations (Type B1) □ Cut Sections (Type B2) □ Sidehill Cut Sections (Type B3) □ Sidehill Cut-Fill Sections (Type B4) □ Sidehill Fill Sections on Unstable Slopes (Type B5) □ Geohazard Borings (Type C) □ Lakes, Ponds, and Low-Lying Areas (Type C1) □ Peat Deposits, Compressible Soils, and Low Strength Soils (Type C2) □ Uncontrolled Fills, Waste Pits, and Reclaimed Surface Mines (Type C3) □ Underground Mines (C4) □ Landslides (Type C5) □ Karst (Type C6) □ Proposed Underground Utilities (Type D) □ Structure Borings (Type E) □ Bridges (Type E1) ■ Culverts (Type E2 a,b,c) □ Retaining Walls (Type E3 a,b,c) □ Noise Barrier (Type E4) □ High Mast Lighting Towers (Type E5) □ Buildings and Salt Domes (Type E6)	

Notes:

IV.A Foundations/Structures - Non-bridge Applications

C-R-S: RIC-3rd St-0313	PID:	Reviewer: RSW	Date: 12/30/19

If you do not have such a foundation or structure on the project, you do not have to fill out this checklist.

Soil and Bedrock Strength Data		
Y N X 1	Has the shear strength of the foundation soils been determined? Check method used: □ laboratory shear tests ■ estimation from SPT or field tests	
Y N X 2	Have sufficient soil shear strength, consolidation, and other parameters been determined so that the required allowable loads for the foundation/structure can be designed?	
Y N X 3	Has the shear strength of the foundation bedrock been determined? Check method used: □ laboratory shear tests □ other List Other items:	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Spread Footings					
Y N	4		Are there spread footings on the project?		
			If no, go to Question **11**		
Y N X	5		Has the recommended bottom of footing elevation and reason for this recommendation been provided?	Estimated inlet/outlet elevations provided.	
Y N X		a	Has the recommended bottom of footing elevation taken scour from streams or other water flow into account?		
	6		Were representative sections analyzed for the entire length of the structure for the following:		
Y N X		a	bearing capacity?		
Y N X		b	sliding?		
Y N X		c	overturning?		
Y N X		d	settlement?		
Y N X	7		Has the need for a shear key been evaluated?	By others	
Y N X		a	If needed, have the details been included in the plans?		
Y N X	8		If special conditions exist (e.g. geometry, sloping rock, varying soil conditions), was the bottom of footing "stepped" to accommodate them?		
Y N X	9		Has the recommended allowable soil or rock bearing pressure been provided?		
Y N X	10		If weak soil is present at the proposed foundation level, has the removal / treatment of this soil been developed and included in the plans?	Section 6.2.1	
Y N X		a	Have the procedure and quantities related to this removal / treatment been included in the plans?	By others	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Pile Structures			
Y N	11	Are there piles on the project?	
		If no, go to Question **17**	
Y N	12	Has an appropriate pile type been selected?	
		Check the type selected:	
		□ H-pile (driven)	
		□ H-pile (drilled)	
		□ Cast In-place Concrete	
		□ other List Other items:	
Y N X	13	Have the estimated pile length or tip elevation and section (diameter) been specified?	
		Check method used:	
		□ SPILE, DRIVEN, or equivalent software	
		□ hand calculations	
	14	If required for design, have sufficient soil parameters been provided and calculations performed to evaluate the:	
Y N X		a Lateral load capacity and maximum deflection of the piles?	
Y N X		b Vertical load capacity and maximum settlement of the piles?	
Y N X		c Negative skin friction on piles driven through new embankment or soft foundation layers?	
Y N X		d Potential for and impact of lateral squeeze from soft foundation soils?	
Y N X	15	If piles are to be driven to bedrock, have “pile points” been recommended to assure secure contact with the rock surface, as per BDM 202.2.3.2.a?	
Y N X	16	If subsurface obstacles exist, has preboring been recommended to avoid these obstructions?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Drilled Shafts			
Y N	17	Are there drilled shafts on the project? If no, go to the next checklist.	
Y N X	18	Have the drilled shaft diameter and embedment length been specified?	
Y N X	19	Have the recommended drilled shaft diameter and embedment been developed based on side friction and end bearing for vertical loading situations?	
	20	For shafts undergoing lateral loading, have the following been determined:	
Y N X		a. maximum lateral shear	
Y N X		b. maximum bending moment	
Y N X		c. maximum deflection	
Y N X		d. reinforcement design	
Y N X	21	Generally, bedrock sockets are 6" smaller in diameter than the soil embedment section of the drilled shaft. Has this factor been accounted for in the drilled shaft design?	
Y N X	22	If a bedrock socket is required below soil embedment, have separate quantities been estimated based on shaft diameters and materials to be excavated?	
Y N X	23	Has the site been assessed for groundwater influence?	
Y N X		a If yes, if artesian flow is a potential concern, does the design address control of groundwater flow during construction?	
Y N X	24	If special construction features (e.g., slurry, casing, load tests) are required, have all the proper items been included in the plans?	

Notes:

Stage 1

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

RIC-3rd St-0313 Culvert

PID

Structure Foundation Exploration

S&ME, Inc.

Prepared By: **Richard S. Weigand, PE**

Date prepared: **December 30, 2019**

BORING LOG LOCATION SUMMARY

Boring ID	Latitude	Longitude	Filename Log	Filename Plan	Filename Profile
B-001-0-19	40.759541N	82.509430W			
B-002-0-19	40.759522N	82.508889W			
B-003-0-19	40.759504N	82.508353W			
B-004-0-19	40.759478N	82.507772W			
B-005-0-19	40.759458N	82.507234W			
B-006-0-19	40.759437M	82.506687W			

Appendix D

PROJECT DESCRIPTION

THIS PROJECT INCLUDES THE REPLACEMENT OF THE APPROXIMATE 840-FOOT LONG EXISTING CULVERT STRUCTURE (SFN 7060696) CARRYING RITTERS RUN UNDER 3rd STREET NEAR DOWNTOWN MANSFIELD, OHIO. THE PROJECT LIMITS EXTEND ALONG 3rd STREET FROM SCOTT STREET TO JUNCTION STREET AT THE NORFOLK & SOUTHERN RAILROAD RIGHT-OF-WAY.

THE REPLACEMENT STRUCTURE WILL CONSIST OF A BOX CULVERT STRUCTURE WITH A 16-FOOT SPAN, A 6-FOOT RISE, CAST-IN-PLACE HEADWALLS AND WINGWALLS AT THE INLET, AND A CAST-IN-PLACE JUNCTION CHAMBER AT THE END OF THE PROJECT. THE NEW CULVERT WILL ESSENTIALLY FOLLOW THE ALIGNMENT OF THE EXISTING CULVERT, WITH MINIMAL TO NO REGRADING OF THE EXISTING ROADWAY ANTICIPATED.

HISTORIC RECORDS

NO HISTORIC BORING INFORMATION WAS AVAILABLE FOR THIS PROJECT.

GEOLOGY

THE PROJECT SITE LIES IN A PREVIOUSLY GLACIATED PORTION OF THE STATE AND WITHIN THE KILLBUCK-GLACIATED PITTSBURGH PLATEAU PHYSIOGRAPHIC REGION. THIS REGION IS CHARACTERIZED BY CLAY TO LOAM GLACIAL TILL OF WISCONSINAN AGE, UNDERLAIN BY MISSISSIPPIAN AND PENNSYLVANIAN-AGE SHALES, SANDSTONES AND CONGLOMERATES. BEDROCK TOPOGRAPHY MAPPING INDICATES THE PRESENCE OF A RELATIVELY DEEP BURIED VALLEY BENEATH THIS SITE, WITH THE DEPTH TO BEDROCK ROUGHLY 200 OR MORE FEET TO THE EAST OF THIS SITE. AS SUCH, BEDROCK WAS NOT ANTICIPATED TO BE ENCOUNTERED WITHIN THE PROPOSED BORING DEPTHS FOR THIS PROJECT. HOWEVER, AUGER REFUSAL ON APPARENT BEDROCK WAS NOTED AT DEPTHS BETWEEN ROUGHLY 29 AND 36 FEET IN THREE OF THE BORINGS. ADDITIONALLY, ODNR GROUNDWATER RESOURCE MAPPING INDICATES THIS SITE IS IN AN AREA WITH HIGH GROUNDWATER YIELDS (400 TO MORE THAN 1,000 GALLONS PER MINUTE) FROM THICK, PERMEABLE DEPOSITS OF SAND AND GRAVEL WITHIN THE BURIED VALLEY. TERRACED ORGANIC AND SILT DEPOSITS ARE ALSO KNOWN TO BE PRESENT WITHIN THIS VALLEY.

A REVIEW OF THE ODNR "OHIO KARST AREAS" MAP REVEALS THAT THE SITE LIES IN AN AREA NOT KNOWN TO CONTAIN KARST FEATURES. A REVIEW OF THE ODNR "LANDSLIDES IN OHIO" MAP REVEALS THAT THE PROJECT SITES LIE IN AN AREA OF LOW INCIDENCE AND LOW SUSCEPTIBILITY TO LANDSLIDES, AND THE ODNR "ABANDONED UNDERGROUND MINES OF OHIO" MAP INDICATES THESE SITES LIE IN AREAS WITH NO MAPPED ABANDONED MINES NEAR THE AREA OF THE PROJECT SITE.

RECONNAISSANCE

A SITE RECONNAISSANCE VISIT WAS MADE BY S&ME PERSONNEL ON JUNE 25, 2019, TO OBSERVE THE EXISTING CULVERT AND PROJECT VICINITY AND TO FIELD MARK THE BORING LOCATIONS. THE RIC-3rd ST.-0313 STRUCTURE CARRIES RITTERS RUN AT A DEPTH OF APPROXIMATELY 9 FEET BENEATH THE PAVED SURFACE OF 3rd STREET.

SUBSURFACE EXPLORATION

ON JULY 10, 11, AND 23, 2019, S&ME PERFORMED SIX (6) BORINGS DESIGNATED B-001-0-19 THROUGH B-006-0-19 TO EXPLORE THE EXISTING SOILS IN THE AREA OF THE PROPOSED REPLACEMENT CULVERT. THE CULVERT BORINGS WERE EXTENDED TO DEPTHS OF 29.4 TO 40 FEET BELOW THE EXISTING GROUND SURFACE.

THE BORINGS WERE PERFORMED USING A TRUCK-MOUNTED DRILLING RIG WITH A 3¼-INCH I.D. HOLLOW-STEM AUGER. DISTURBED (BUT REPRESENTATIVE) SOIL SAMPLES WERE OBTAINED BY LOWERING A 2-INCH O.D. SPLIT-BARREL SAMPLER TO THE BOTTOM OF THE BORING AND THEN DRIVING THE SAMPLER INTO THE SOIL WITH BLOWS FROM A 140-POUND HAMMER FREELY FALLING 30 INCHES (AASHTO T206 - STANDARD PENETRATION TEST, SPT). IN ACCORDANCE WITH THE CURRENT ODOT SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS (SGE), THE HAMMER SYSTEM ON THE DRILL RIG HAD BEEN CALIBRATED IN ACCORDANCE WITH ASTM D4633 TO DETERMINE THE DRILL ROD ENERGY RATIO (81.8%).

SPT SAMPLING WAS PERFORMED AT 2.5-FOOT INTERVALS FROM 8.5 TO 30 FEET, AND AT 5 FOOT INTERVALS IN THE REMAINDER OF THE BORINGS UNTIL EITHER AUGER REFUSAL WAS ENCOUNTERED OR THE PLANNED TERMINATION DEPTH OF 40 FEET WAS ENCOUNTERED.

EXPLORATION FINDINGS

ALL OF THE BORINGS WERE ADVANCED THROUGH EXISTING PAVEMENTS WITH ASPHALT THICKNESSES RANGING FROM 4 TO 5½ INCHES AND BRICK THICKNESSES RANGING FROM 6 TO 8 INCHES. A DEFINITIVE LAYER OF GRANULAR BASE WAS NOT OBSERVED BENEATH THE BRICK LAYER IN ANY OF THE BORINGS.

BELOW THE EXISTING PAVEMENT MATERIALS, THE BORINGS GENERALLY ENCOUNTERED 8 TO 13 FEET OF EXISTING FILL AND POSSIBLE FILL WHICH CONSISTED VARIABLY OF LOOSE TO MEDIUM-DENSE COARSE AND FINE SAND (A-3a) OR GRAVEL WITH SAND (A-1-b), STIFF TO HARD SANDY SILT (A-4a), AND HARD SILTY CLAY (A-6b). BENEATH THE FILL, DISCONTINUOUS DEPOSITS OF NATURAL SOILS WERE ENCOUNTERED, INCLUDING MEDIUM-STIFF TO VERY-STIFF COHESIVE SANDY SILT (A-4a), SILT AND CLAY (A-6a), AND SILTY CLAY (A-6b), AND LOOSE TO DENSE GRAVEL WITH SAND (A-1-b), COARSE AND FINE SAND (A-3a), GRAVEL WITH SAND AND SILT (A-2-4), AND SANDY SILT (A-4a). IT SHOULD BE NOTED THAT DURING LABORATORY TESTING, SEVERAL SAMPLES OF SOIL RECOVERED FROM BORINGS B-005-0-19 CONTAINED A VERY-STRONG HYDROCARBON ODOR.

BORINGS B-001, B-002, AND B-006 WERE TERMINATED AT THE DEPTHS OF 33.7, 36.2, AND 29.4 FEET, RESPECTIVELY, AFTER ENCOUNTERING REFUSAL ON HIGHLY TO SEVERELY WEATHERED, VERY-WEAK TO WEAK SANDSTONE BEDROCK.

DURING DRILLING, GROUNDWATER AND GROUNDWATER SEEPAGE WERE INITIALLY ENCOUNTERED BETWEEN THE DEPTHS OF 8.5 AND 21 FEET BELOW THE GROUND SURFACE. MEASUREMENTS TAKEN INSIDE THE HOLLOW-STEM AUGERS AT THE COMPLETION OF DRILLING RECORDED WATER HAVING ACCUMULATED TO DEPTHS RANGING FROM 11.8 TO 20.7 FEET BELOW THE GROUND SURFACE.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH.	CLASSIFIED VISUAL
GRAVEL WITH SAND	*A-1-b*	*--*	*19*
GRAVEL WITH SAND AND SILT	*A-2-4*	*1*	*1*
COARSE AND FINE SAND	*A-3a*	*2*	*9*
SANDY SILT	*A-4a*	*6*	*15*
SILT AND CLAY	*A-6a*	*1*	*13*
SILTY CLAY	*A-6b*	*3*	*5*
	TOTAL	*13*	*62*
SANDSTONE	*VISUAL*		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	*VISUAL*		

BORING LOCATION - PLAN VIEW

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

WC INDICATES WATER CONTENT IN PERCENT.

N_{60} INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

X/D" NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.

X/Y/D" NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X= NUMBER OF BLOWS FOR FIRST 6 INCHES (UNCORRECTED).
Y/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.

X/Y/Z/D" NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X= NUMBER OF BLOWS FOR FIRST 6 INCHES (UNCORRECTED).
Y= NUMBER OF BLOWS FOR SECOND 6 INCHES (UNCORRECTED).
Z/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.

W— INDICATES FREE WATER ELEVATION.

● INDICATES A PLASTIC MATERIAL WITH A MOISTURE CONTENT EQUAL TO OR GREATER THAN THE LIQUID LIMIT MINUS 3.

NP INDICATES A NON-PLASTIC SAMPLE.

SS INDICATES A SPLIT SPOON SAMPLE, STANDARD PENETRATION TEST.

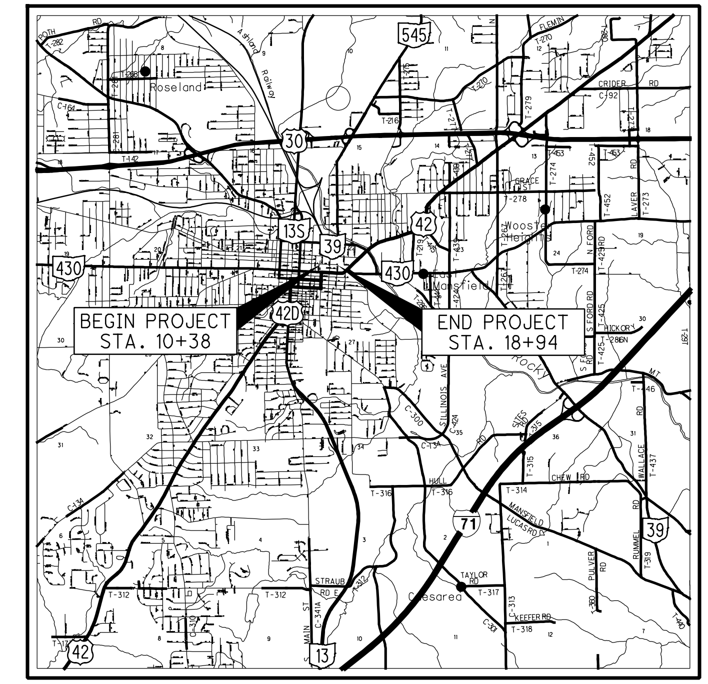
TR— INDICATES TOP OF BEDROCK.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2019.

AVAILABLE INFORMATION

ALL AVAILABLE SOIL AND BEDROCK INFORMATION THAT CAN BE CONVENIENTLY SHOWN ON THE GEOTECHNICAL EXPLORATION SHEETS HAS BEEN SO REPORTED. ADDITIONAL EXPLORATIONS MAY HAVE BEEN MADE TO STUDY SOME SPECIAL ASPECT OF THE PROJECT. COPIES OF THIS DATA, IF ANY, MAY BE INSPECTED IN THE DISTRICT DEPUTY DIRECTOR'S OFFICE OR THE OFFICE OF GEOTECHNICAL ENGINEERING AT 1980 WEST BROAD STREET.



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

PARTICLE SIZE DEFINITIONS

	12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
			No. 10 SIEVE	No. 40 SIEVE	No. 200 SIEVE	

RECON. - BKS 6/25/19

DRILLING - S&ME 7/10/19-7/11/19, 7/23/19

DRAWN - KAH 1/10/20 - 1/23/20

REVIEWED - NDA 1/22/20

STATE OF OHIO
NATHAN DANIEL ABELE
E-76734
REGISTERED
PROFESSIONAL ENGINEER

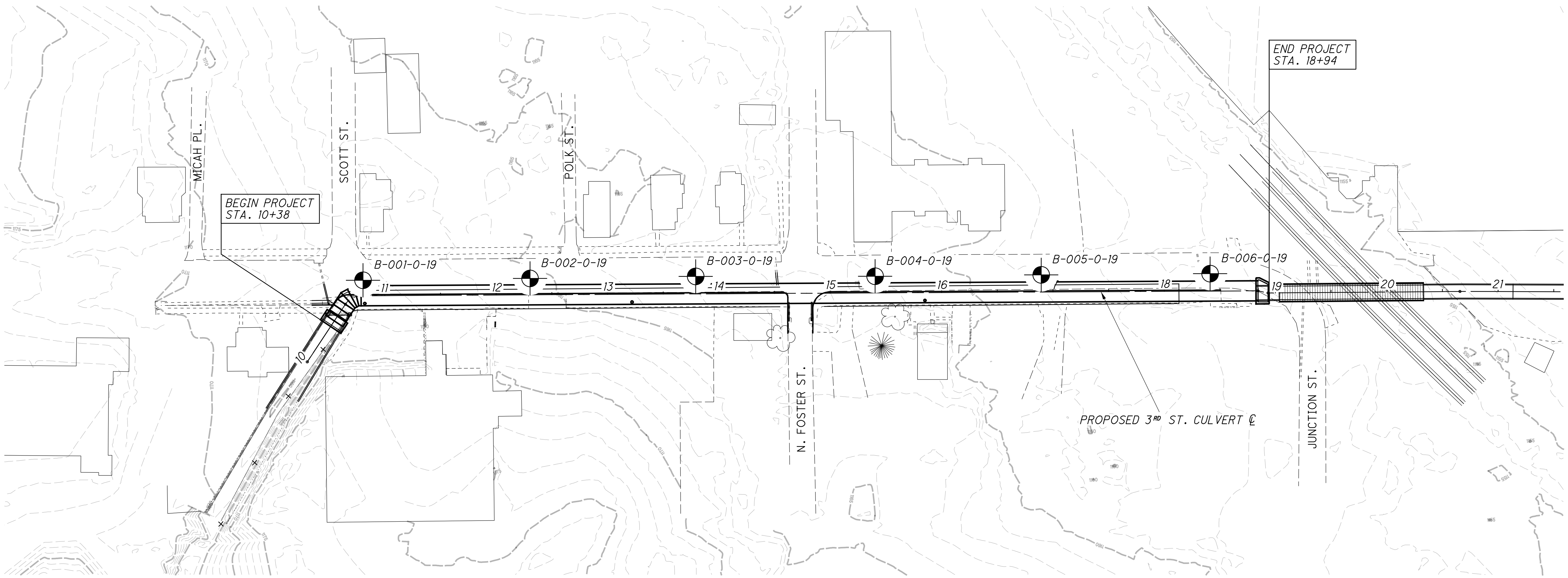
6190 ENTERPRISE COURT
DUBLIN, OHIO 43016
(614) 793-2226

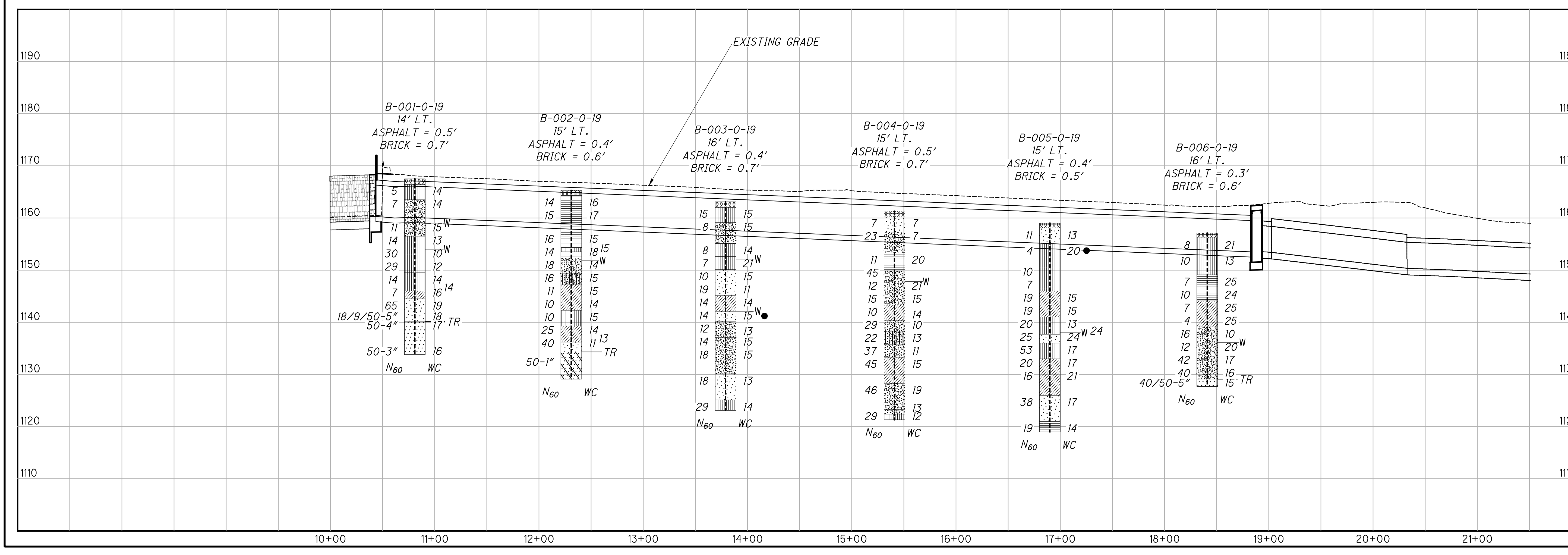
PID NO. N/A

RIC-3RD ST.-0313 RITTERS RUN CULVERT UNDER 3RD ST.
STRUCTURE FOUNDATION EXPLORATION

RIC-3RDST-3.13

1/8





HORIZONTAL SCALE IN FEET
0 50 100

DRAWN KAH
CHECKED NDA

STRUCTURE FOUNDATION EXPLORATION
RIC-3RD ST.-0313 RITTERS RUN CULVERT UNDER 3RD ST.

RIC-3RDST-3.13

2 / 8

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 10+81, 14' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1167.5 (MSL) EOB: 33.7 ft.
START: 7/10/19 END: 7/10/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759541 N, 82.509430 W

EXPLORATION ID: **B-001-0-19** — PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. (1167.5)	DEPTHS
ASPHALT - 5-1/2 INCHES	1167.1	
BRICK - 8 INCHES	1166.4	
Fill: Stiff to very-stiff brown **SANDY SILT**, little clay, little fine to coarse gravel, moist.	1163.5	
Probable Fill: Loose to medium dense brown **GRAVEL WITH SAND**, little silt, trace clay, few cobbles, contains iron oxide stains, damp.	1156.5	W 1159.0
Very-stiff to hard gray **SANDY SILT**, little to some clay, trace to little fine to coarse gravel, few cobbles, damp.	1149.5	W 1154.0
Stiff to very-stiff gray **SANDY SILT**, some clay, little fine to coarse gravel, damp to moist.	1146.0	
Stiff gray and brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, moist to wet.	1144.5	
Dense to very-dense brown **COARSE AND FINE SAND**, little fine to coarse gravel, trace silt, trace clay, wet.	1140.1	TR
SANDSTONE, brown, highly to severely weathered, very weak to weak, highly fractured, partly similar to very-dense gravel.	1133.8	EOB

Depth (ft)	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
2	4 2 2	5	39	SS-1	1.2-3.0	-	-	-	-	-	-	-	-	14	A-4a (V)
5	2 2 3	7	56	SS-2	-	-	-	-	-	-	-	-	-	14	A-1-b (V)
9	2 3 5	11	33	SS-3	-	47	18	16	12	7	-	-	-	15	A-1-b (V)
12	2 3 7	14	33	SS-4	3.0-4.0	-	-	-	-	-	-	-	-	13	A-4a (V)
14	2 7 15	30	39	SS-5	3.0-4.2	19	9	19	32	21	20	14	6	10	A-4a (4)
17	5 10 11	29	100	SS-6	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)
19	3 4 6	14	56	SS-7	1.0-2.5	-	-	-	-	-	-	-	-	14	A-4a (V)
22	1 2 3	7	39	SS-8	1.0-1.2	13	12	18	35	22	21	14	7	14	A-4a (4)
					1.0-1.5	-	-	-	-	-	-	-	-	16	A-6a (V)
24	11 27 21	65	50	SS-9	-	19	6	61	8	6	-	-	-	19	A-3a (V)
27	18 9 50-5"	-	71	SS-10	-	-	-	-	-	-	-	-	-	18	A-3a (V)
28.5	50-4"	-	75	SS-11	-	-	-	-	-	-	-	-	-	17	Rock (V)
33.5	50-3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	16	Rock (V)

- Seepage noted at 8.5'.
- Water noted at 13.5'.
- Cobbles noted at 10.5' and 15.0'.
- Auger refusal encountered at 33.7'.
- At completion, water measured at 20.7' inside HSA.
- Boring caved at 24.2' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 12+31, 15' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1165.3 (MSL) EOB: 36.2 ft.
START: 7/10/19 END: 7/10/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759522 N, 82.508889 W

EXPLORATION ID: B-002-0-19 — PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. (top 1165.3)
ASPHALT - 5 INCHES	1164.9
BRICK - 7 INCHES	1164.3
Fill: Very-stiff to hard brown and dark-brown **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp to moist.	1161.3
Possible Fill: Hard brown mottled with gray **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp to moist.	1157.3
Very-stiff dark-brown **SILTY CLAY**, little fine to coarse sand, trace fine to coarse gravel, damp.	1154.3
Stiff to very-stiff gray **SANDY SILT**, some clay, trace fine to coarse gravel, damp.	1153.5
Stiff to very-stiff brown **SILTY CLAY**, some fine to coarse sand, little fine to coarse gravel, contains silt seams, damp to moist.	1152.3
Medium-dense brown **GRAVEL WITH SAND**, little silt, trace clay, moist.	1149.3
Medium-dense brown **GRAVEL WITH SAND AND SILT**, trace clay, damp.	1147.3
Stiff to very-stiff gray and brown **SILT AND CLAY**, little fine to coarse sand, trace to little fine to coarse gravel, damp.	1142.3
Stiff gray **SANDY SILT**, some fine to coarse sand, little fine to coarse gravel, damp.	1139.3
Very-stiff to hard gray **SILT AND CLAY**, little fine to coarse sand, trace fine to coarse gravel, contains silt lenses, damp.	1136.2
Medium-dense brown **COARSE AND FINE SAND**, little fine gravel, little clayey silt.	1134.3
SANDSTONE, brown, highly to severely weathered, very-weak to weak, fractured.	1129.1

DEPTHS: W 1151.8 (at 13'); TR (at 31'); EOB (at 36.2')

DEPTH (ft)	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
1.5–3	3 4 6	14	100	SS-1	2.5-4.5	-	-	-	-	-	-	-	-	16	A-6b (V)
4–5.5	5 4 7	15	61	SS-2	4.5+	1	2	16	27	54	37	18	19	17	A-6b (12)
8.5–10	4 5 7	16	33	SS-3	2.2-2.7	-	-	-	-	-	-	-	-	15	A-6b (V)
11–12.5	2 3 7	14	72	SS-4	1.5-2.5	7	6	18	36	33	25	16	9	15	A-4a (7)
					1.7-2.5	-	-	-	-	-	-	-	-	18	A-6b (V)
13.5–15	4 5 8	18	56	SS-5	-	-	-	-	-	-	-	-	-	14	A-1-b (V)
16–17.5	4 6 6	16	61	SS-6	-	29	15	24	24	8	-	-	-	15	A-2-4 (V)
18.5–20	2 3 5	11	33	SS-7	2.0-2.5	-	-	-	-	-	-	-	-	15	A-6a (V)
21–22.5	2 3 4	10	39	SS-8	1.2-3.0	-	-	-	-	-	-	-	-	14	A-6a (V)
23.5–25	3 3 4	10	33	SS-9	1.0-1.5	18	9	18	29	26	23	14	9	15	A-4a (4)
26–27.5	4 8 10	25	100	SS-10	2.2-3.5	-	-	-	-	-	-	-	-	14	A-6a (V)
28.5–30	5 11 18	40	67	SS-11	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)
					-	-	-	-	-	-	-	-	-	11	A-3a (V)
33.5–36.2	50-1"	-	0	--	-	-	-	-	-	-	-	-	-	-	Rock (V)

- Water noted at 13.5'.
- Auger refusal encountered at 36.2'.
- At completion, water measured at 12.4' inside HSA.
- Boring caved at 27.4' after augers removed.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

STRUCTURE FOUNDATION EXPLORATION LOG OF BORING B-002-0-19

DRAWN KAH CHECKED NDA

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 13+79, 16' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1163.1 (MSL) EOB: 40.0 ft.
START: 7/11/19 END: 7/11/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759504 N, 82.508353 W

EXPLORATION ID: **B-003-0-19** PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.
	1163.1
ASPHALT - 5 INCHES	1162.7
BRICK - 8 INCHES	1162.0
Fill: Stiff to very-stiff brown and gray **SANDY SILT**, some clay, trace fine to coarse gravel, damp to moist.	1159.1
Fill: Loose brown **GRAVEL WITH SAND**, trace silt, trace clay, damp to moist.	1155.1
Possible Fill: Stiff to very-stiff brown and gray **SANDY SILT**, little clay, trace fine to coarse gravel, damp.	1152.6
Loose brown **SANDY SILT**, little clay, trace fine to coarse gravel, moist.	1150.1
Loose to medium-dense brown **COARSE AND FINE SAND**, trace to little clay, trace to little silt, little to some fine to coarse gravel, damp.	1145.1
Very-stiff to hard gray **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, damp to moist.	1142.1
Medium-dense gray **COARSE AND FINE SAND**, little fine to coarse gravel, little silt, little clay, wet.	1140.1
Medium-dense brown **GRAVEL WITH SAND**, trace silt, trace clay, wet.	1137.1
Medium-dense gray **GRAVEL WITH SAND**, little silt, trace clay, wet.	1130.1
Medium-dense brown **COARSE AND FINE SAND**, some fine to coarse gravel, little silt, trace clay, wet.	1125.1
Stiff to very-stiff gray **SANDY SILT**, little fine to coarse gravel, some clay, wet.	1123.1

DEPTHS: W 1152.1; W 1142.1; EOB at 40

SPT/RQD	N60	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
5 5 6	15	72	SS-1	1.0-3.5	-	-	-	-	-	-	-	-	15	A-4a (V)
4 1 5	8	50	SS-2	-	-	-	-	-	-	-	-	-	15	A-1-b (V)
5 3 3	8	61	SS-3	1.2-2.7	-	-	-	-	-	-	-	-	14	A-4a (V)
2 3 2	7	100	SS-4	-	-	-	-	-	-	-	-	-	21	A-4a (V)
2 2 5	10	72	SS-5	-	19	19	32	18	12	NP	NP	NP	15	A-3a (0)
4 7 7	19	61	SS-6	-	-	-	-	-	-	-	-	-	11	A-3a (V)
4 5 5	14	67	SS-7	3.5-4.5	-	-	-	-	-	-	-	-	14	A-6a (V)
2 5 5	14	56	SS-8	-	13	29	23	20	15	17	12	5	15	A-3a (0)
2 4 5	12	0	--	-	-	-	-	-	-	-	-	-	-	
6	-	100	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-b (V)
3 4 6	14	33	SS-10	-	30	27	24	11	8	-	-	-	15	A-1-b (V)
5 8 5	18	50	SS-11	-	-	-	-	-	-	-	-	-	15	A-1-b (V)
8 6 7	18	39	SS-12	-	-	-	-	-	-	-	-	-	13	A-3a (V)
2 7 14	29	56	SS-13	1.7-3.2	-	-	-	-	-	-	-	-	14	A-4a (V)

- Seepage noted at 11.0'.
- Water noted at 21.0'.
- At completion, water measured at 16.1' inside HSA.
- Boring caved at 23.2', after augers removed.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

RIC-3RDST-3.13

STRUCTURE FOUNDATION EXPLORATION
LOG OF BORING B-003-0-19

DRAWN KAH
CHECKED NDA

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 15+41, 15' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1161.3 (MSL) EOB: 40.0 ft.
START: 7/11/19 END: 7/11/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759478 N, 82.507772 W

EXPLORATION ID: **B-004-0-19** — PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1161.3	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
ASPHALT - 5-1/2 INCHES	1160.9																	
BRICK - 8 INCHES	1160.2																	
Fill: Loose brown **COARSE AND FINE SAND**, some fine to coarse gravel, little silt, little clay, damp.	1157.3	1.5–3	4, 3, 2	7	56	SS-1	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
Possible Fill: Medium-dense brown **GRAVEL WITH SAND**, trace silt, few sandstone fragments, damp.	1153.3	4–5.5	8, 7, 10	23	61	SS-2	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
Very-stiff brown mottled with gray **SILTY CLAY**, some fine to coarse sand, little fine gravel, contains iron oxide stains, moist.	1149.8	8.5–10	3, 3, 5	11	61	SS-3	2.0-3.7	11	5	22	29	33	35	17	18	20	A-6b (9)	
Medium-dense to dense brown **GRAVEL WITH SAND**, little silt, trace clay, wet.	1143.3	11–12.5	4, 16, 17	45	0	--	-	-	-	-	-	-	-	-	-	-		
		12.5–13 (W 1147.8)	12	-	0	--	-	-	-	-	-	-	-	-	-	-		
		13.5–15	2, 4, 5	12	33	SS-5	-	-	-	-	-	-	-	-	-	21	A-1-b (V)	
		16–17.5	2, 5, 6	15	33	SS-6	-	40	14	26	14	6	-	-	-	15	A-1-b (V)	
Very-stiff brown **SILT AND CLAY**, some fine to coarse sand, trace fine to coarse gravel, damp.	1140.3	18.5–20	8, 3, 4	10	0	--	-	-	-	-	-	-	-	-	-	-		
		20–20.5	5	-	100	SS-7	3.0-4.0	-	-	-	-	-	-	-	-	14	A-6a (V)	
Medium-dense gray **GRAVEL WITH SAND**, little silt, trace clay, wet.	1138.3	21–22.5	5, 9, 12	29	33	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
Medium-dense gray and brown **GRAVEL WITH SAND AND SILT**, little clay, wet.	1135.8	23.5–25	6, 8, 8	22	50	SS-9	-	33	19	19	15	14	18	12	6	13	A-2-4 (0)	
Dense brown **GRAVEL WITH SAND**, little silt, trace clay, wet.	1133.3	26–27.5	12, 12, 15	37	33	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
Stiff to very-stiff brown **SILT AND CLAY**, some fine to coarse sand, little fine to coarse gravel, wet.	1128.3	28.5–30	15, 15, 18	45	67	SS-11	1.0-2.7	-	-	-	-	-	-	-	-	15	A-6a (V)	
Dense gray **GRAVEL WITH SAND**, trace silt, trace clay, wet.	1123.3	33.5–35	12, 16, 18	46	50	SS-12	-	20	40	28	6	6	-	-	-	19	A-1-b (V)	
Medium-dense brown **GRAVEL WITH SAND**, little silt, wet.	1122.4						-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
Very-stiff to hard gray **SANDY SILT**, little fine to coarse gravel, some clay, damp.	1121.3	38.5–40 (EOB)	7, 9, 12	29	56	SS-13	3.2-4.5	-	-	-	-	-	-	-	-	12	A-4a (V)	

- Water noted at 13.5'.
- At completion, water measured at 19.2' inside HSA.
- Boring caved at 22.3' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

STRUCTURE FOUNDATION EXPLORATION
LOG OF BORING B-004-0-19

DRAWN KAH CHECKED NDA

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313	DRILLING FIRM / OPERATOR: S&ME / D. GODWIN	DRILL RIG: S&ME TRK 55	STATION / OFFSET: 16+90, 15' LT
TYPE: CULVERT REPLACEMENT	SAMPLING FIRM / LOGGER: S&ME / D. GODWIN	HAMMER: SAFETY HAMMER	ALIGNMENT: CL CULVERT
PID: BR ID: RIC-3RDS-00313	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/13/17	ELEVATION: 1159.0 (MSL) EOB: 40.0 ft.
START: 7/23/09 END: 7/23/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.8	COORD: 40.759458 N, 82.507234 W

EXPLORATION ID: B-005-0-19 — PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. (top 1159.0)
ASPHALT - 4-1/2 INCHES	1158.7
BRICK - 6 INCHES	1158.1
Fill: Medium-dense brown **COARSE AND FINE SAND**, little fine to coarse gravel, little silt, little clay, moist.	1155.0
Fill: Medium stiff to stiff brown and gray **SANDY SILT**, little to some clay, trace fine to coarse gravel, very-strong hydrocarbon odor, moist.	1146.0
Stiff to very-stiff brown **SILT AND CLAY**, little fine to coarse sand, little fine to coarse gravel, moist.	1141.0
Very-stiff gray **SANDY SILT**, some clay, trace fine gravel, moist to wet.	1137.7
Medium-dense brown **COARSE AND FINE SAND**, some silt, trace clay, wet.	1136.0
Very-dense brown **SANDY SILT**, little clay, some fine to coarse gravel, very-strong hydrocarbon odor, wet.	1133.0
Stiff to very-stiff brown and gray **SILT AND CLAY**, little to some fine to coarse sand, trace fine to coarse gravel, moist.	1126.0
Medium-dense to dense gray and brown **COARSE AND FINE SAND**, trace fine to coarse gravel, little to some silt, trace clay, few cobbles, moist.	1121.0
Very-stiff gray **SILTY CLAY**, some fine to coarse sand, trace fine to coarse gravel, damp to moist.	1119.0

W 1138.0 — EOB at 40

DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
1.5–3.0	10 5 3	11	50	SS-1	-	-	-	-	-	-	-	-	-	13	A-3a (V)
4.5–6.0	1 2 1	4	33	SS-2	1.0	9	7	35	30	19	23	15	8	20	A-4a (3)
8.5–10.0	1 3 4	10	61	SS-3	1.0-2.0	-	-	-	-	-	-	-	-	-	A-4a (V)
11.0–12.5	1 2 3	7	33	SS-4	0.7-1.2	-	-	-	-	-	-	-	-	-	A-4a (V)
13.5–15.0	3 5 9	19	56	SS-5	3.0-3.7	-	-	-	-	-	-	-	-	15	A-6a (V)
16.0–17.5	3 7 7	19	33	SS-6	1.5-2.5	-	-	-	-	-	-	-	-	15	A-6a (V)
18.5–20.0	3 6 9	20	33	SS-7	3.0-3.5	8	8	18	35	31	25	16	9	13	A-4a (6)
21.0–22.5	4 7 11	25	56	SS-8	2.0-2.2	-	-	-	-	-	-	-	-	24	A-4a (V)
					-	-	-	-	-	-	-	-	-	24	A-3a (V)
23.5–25.0	10 14 25	53	33	SS-9	-	24	8	20	30	18	-	-	-	17	A-4a (V)
26.0–27.5	5 7 8	20	39	SS-10	1.2-3.5	-	-	-	-	-	-	-	-	17	A-6a (V)
28.5–30.0	3 5 7	16	33	SS-11	1.2-3.0	-	-	-	-	-	-	-	-	21	A-6a (V)
33.5–35.0	5 12 16	38	22	SS-12	-	-	-	-	-	-	-	-	-	17	A-3a (V)
38.5–40.0	5 6 8	19	56	SS-13	2.7-3.5	-	-	-	-	-	-	-	-	14	A-6b (V)

- Water noted at 21.0'.
- Cobbles noted at 33.0'.
- At completion, water measured at 13.4' inside HSA.
- Boring caved at 29.3' after augers pulled.

NOTES: SEE ABOVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

S&ME JOB: 1117-19-038

PROJECT: RIC-3RD STREET-0313
TYPE: CULVERT REPLACEMENT
PID: BR ID: RIC-3RDS-00313
START: 7/23/19 END: 7/23/19

DRILLING FIRM / OPERATOR: S&ME / D. GODWIN
SAMPLING FIRM / LOGGER: S&ME / D. GODWIN
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: S&ME TRK 55
HAMMER: SAFETY HAMMER
CALIBRATION DATE: 12/13/17
ENERGY RATIO (%): 81.8

STATION / OFFSET: 18+41, 16' LT
ALIGNMENT: CL CULVERT
ELEVATION: 1157.1 (MSL) EOB: 29.4 ft.
COORD: 40.759437 N, 82.506687 W

EXPLORATION ID: B-006-0-19
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1157.1	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
ASPHALT - 4 INCHES	1156.8																
BRICK - 7 INCHES	1156.2																
Fill: Stiff to very-stiff brown and dark-brown **SANDY SILT**, some clay, trace fine to coarse gravel, few medium-stiff zones, few brick fragments, damp to moist.		2	12 4 2	8	39	SS-1	0.7-2.5	-	-	-	-	-	-	-	-	21	A-4a (V)
	1149.1	5	8 4 3	10	33	SS-2	2.5	-	-	-	-	-	-	-	-	13	A-4a (V)
Very-stiff brown mottled with gray **SILTY CLAY**, trace fine to coarse sand, trace fine gravel, contains silt seams, moist.		9	2 2 3	7	100	SS-3	2.0-2.5	1	2	3	45	49	37	20	17	25	A-6b (11)
	1144.1	11	2 3 4	10	100	SS-4	2.5-3.5	-	-	-	-	-	-	-	-	24	A-6b (V)
Stiff brown mottled with gray **SILT AND CLAY**, trace fine to coarse sand, contains silt seams, contains iron oxide filled dessication cracks, moist.		14	2 2 3	7	100	SS-5	1.0-1.7	0	2	3	50	45	32	19	13	25	A-6a (9)
	1139.1	16	1 1 2	4	83	SS-6	1.0-1.2	-	-	-	-	-	-	-	-	25	A-6a (V)
Medium-dense brown **GRAVEL WITH SAND**, little silt, trace clay, moist to wet.		19	2 5 7	16	33	SS-7	-	59	13	12	11	5	-	-	-	10	A-1-b (V)
	W 1136.1	21	4 5 4	12	72	SS-8	-	-	-	-	-	-	-	-	-	20	A-1-b (V)
Dense gray and brown **GRAVEL WITH SAND**, little silt, trace clay, wet.	1134.1	24	4 21 10	42	56	SS-9	-	-	-	-	-	-	-	-	-	17	A-1-b (V)
	1129.1	26	18 14 15	40	39	SS-10	-	-	-	-	-	-	-	-	-	16	A-1-b (V)
SANDSTONE, brown, highly to severely weathered, very-weak to weak, highly fractured.	1127.7	28 (TR), 29 (EOB)	40 50-5"	-	55	SS-11	-	-	-	-	-	-	-	-	-	15	A-1-b (V)

NOTES: WATER NOTED AT 21.0'; ENCOUNTERED AUGER REFUSAL AT 29.4' AND BORING TERMINATED; AT COMPLETION, WATER AT 11.8' INSIDE HSA.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; SOIL CUTTINGS MIXED WITH BENTONITE

RIC-3RDST-3.13

STRUCTURE FOUNDATION EXPLORATION
LOG OF BORING B-006-0-19

DRAWN KAH
CHECKED NDA