Resource International, Inc.

FRA-70/71-13.10/14.36 PROJECT 6A/6R
PID NO. 89464 AND 105588
FRANKLIN COUNTY, OHIO

DRAFT ROADWAY EXPLORATION REPORT

Prepared For:
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2221 Schrock Road
Columbus, OH 43229-1547

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Rii Project No. W-13-072

April 2020

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Planning

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April 8, 2020

Mr. Walid Antonios, P.E.
ms consultants, inc.
2221 Schrock Road
Columbus, OH 43229-1547

Re: Draft Roadway Exploration Report
FRA-70/71-13.10/14.36 Project 6A/6R
PID No. 89464 and 105588
Franklin County, Ohio
Rii Project No. W-13-072

Mr. Antonios:

Resource International, Inc. (Rii) is pleased to submit this draft roadway exploration report for the above referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This report includes roadway subgrade recommendations for the design and construction of the proposed FRA-70-13.10 Project 6A and FRA-71-14.36 Project 6R in Franklin County, Ohio.

We sincerely appreciate the opportunity to be of service to you on this project. If you have any questions regarding the roadway exploration or this report, please contact us.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Brian R. Trenner, P.E.
Director – Geotechnical Services

Jonathan P. Sterenberg, P.E.
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Enclosure: Draft Roadway Exploration Report

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EXECUTIVE SUMMARY

This report is a presentation of the roadway exploration performed for the design and construction of the roadway alignments for the FRA-70-13.10 and FRA-71-14.36 Phases 6A and 6R in Franklin County, Ohio. It is understood that subgrade evaluation and stabilization will need to occur along the portions of the various roadway and ramp alignments where cuts or fills up to 3.0 feet are required. The alignments included in the various analyses are along I-70 westbound, I-71 southbound, Ramps B3, D6, D3N, D6, D7, W. Mound Street and Short Street.

Between July 16, 2013, and January 22, 2020, nineteen (19) soil borings, designated as B-020-2-13 through B-115-1-13, were advanced to completion depths ranging from 7.2 to 102.0 feet below the existing ground surface along the various alignments. In addition to the borings performed by Rii as part of the current exploration, twelve (12) soil borings, designated as B-025-0-08 through B-115-0-09, were performed by DLZ along the various alignments as part of the FRA-70-8.93 preliminary exploration (PID 77369), and their findings were published in a reports dated January and May, 2010. The borings were advanced to a completion depths ranging from 7.0 to 59.3 feet below the existing ground surface.

The subsurface conditions encountered in the borings performed along the various alignments is described in Section 4 of the full report.

Subgrade Recommendations

It is understood that subgrade evaluation and stabilization will need to occur along the portions of the various roadway and ramp alignments where cuts are required or where fills up to 3.0 feet are required. Based on a review of the plan information provided, the following alignments will require subgrade stabilization:

- I-70 WB – Sta. 182+00 to End Project
- I-71 SB – Begin Project to Sta. 221+10
- Ramp B3 – Entire Alignment
- Ramp D3N – Entire Alignment
- Ramp D6 – Sta. 6003+50 to End Alignment
- Ramp D7 – Sta. 7012+35 to End Alignment
- W. Mound Street – Entire Alignment
- Short Street – Entire Alignment
- Side Streets: Civic Center Drive, Jewett Street, Second Street, Ludlow Street – Entire Alignments

I-70 Westbound (Sta. 182+00 to End Project)

Seven (7) borings were utilized in the analysis of the subgrade along I-70 westbound between Sta. 182+00 to the end project alignment. The granular soils encountered were comprised of loose to dense gravel, gravel with sand, and coarse and fine sand (ODOT A-1-a, A-1-b, A-3a). The cohesive soils encountered were comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a).

It is recommended that pavement design be based on the CBR value of 9 with a corresponding resilient modulus, M_R, of 10,800 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 190 pci and a soil support value (SSV) of 5.7.

Average Site Parameters (I-70 WB)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
22	6	8	8	3	9

It is recommended that the subgrade along the alignment for the final FRA-70-13.10 Project 6A configuration be chemically stabilized with 12-inches of cement, as per ODOT Item 206.

I-71 Southbound (Begin Project to Sta. 221+10) and Ramp B3

Seven (7) borings were utilized in the analysis of the subgrade along I-71 southbound between the begin project alignment and Sta. 221+10. The cohesive soils encountered were comprised of medium stiff to very stiff sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The granular soils encountered were comprised of loose to medium dense gravel and gravel with sand (ODOT A-1-a, A-1-b).

It is recommended that pavement design be based on the CBR value of 8 with a corresponding resilient modulus, M_R, of 9,600 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 175 pci and a soil support value (SSV) of 5.3.

Average Site Parameters (I-71 SB)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
10	14	14	12	5	8

Five (5) borings were utilized in the analysis of the subgrade along Ramp B3. The cohesive soils encountered were comprised of soft to very stiff sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b). The granular soils encountered were comprised of loose to medium dense gravel and gravel with sand (ODOT A-1-a, A-1-b).

It is recommended that pavement design be based on the CBR value of 7 with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Average Site Parameters (Ramp B3)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
13	16	17	12	7	7

It is recommended that the subgrade along the alignment of I-71 southbound between the begin project alignment and Sta. 221+10 and along the entire alignment of Ramp B3 be chemically stabilized with 12-inches of cement, as per ODOT Item 206.

Ramp D3N

Three (3) borings were utilized in the analysis of the subgrade along Ramp D3N. The cohesive soils encountered were comprised of stiff to very stiff silt and clay and silty clay (ODOT A-6a, A-6b). The granular soils encountered were comprised of medium dense to very dense gravel with sand and coarse and fine sand (ODOT A-1-b, A-3a).

It is recommended that pavement design be based on the CBR value of 7 with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Average Site Parameters (Ramp D3N)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
16	16	13	11	7	7

It is recommended that the subgrade along the entire alignment of Ramp D3N be chemically stabilized with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil.

W. Mound Street, Short Street, Side Streets and Ramps D6/D7

Seven (7) borings were utilized in the analysis of the subgrade along W. Mound Street. The cohesive soils encountered were comprised of stiff to very stiff sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The granular soils encountered were comprised of loose to medium dense gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

It is recommended that pavement design be based on the CBR value of 7 with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Average Site Parameters (W. Mound Street)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
10	12	15	11	6	7

Six (6) borings were utilized in the analysis of the subgrade along Short Street. The cohesive soils encountered were comprised of stiff sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b). The granular soils encountered were comprised of loose to medium dense gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

It is recommended that pavement design be based on the CBR value of 7 with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Average Site Parameters (Short Street)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
8	14	19	13	7	7

The subgrade should be excavated 6.0-inches and a Mirafi RS580i geosynthetic reinforced geotextile shall be placed at the bottom of the excavation. Please note the material is classified as a geosynthetic reinforced geotextile, but should be installed in accordance with ODOT Item 204.07B (Geogrid) per the manufacturers specification. It is not recommended to proof roll the subgrade prior to placing the geosynthetic reinforced geotextile, as proof rolling may lead to disturbing or destabilizing the existing subgrade, or potentially damaging the existing shallow utilities. The excavation should be backfilled with 6.0 inches of ODOT Item 304 aggregate base. Per the design plans provided, the pavement section along both streets as well as the side streets and ramps include 6.0 inches of ODOT Item 304 as part of the design pavement section. Where ODOT Item 304 is included in the pavement section, it is recommended that this be placed at the same time as the 6.0 inches of ODOT Item 304 for the subgrade stabilization. It is further recommended that the total thickness of ODOT Item 304 be placed and compacted in a single lift. Proof rolling can then be performed on top of the compacted 304 material.

Please note that this executive summary does not contain all the information presented in the report. The unabridged geotechnical exploration report should be read in its entirety to obtain a more complete understanding of the information presented.

1. INTRODUCTION

The overall purpose of this project is to provide detailed subsurface information and recommendations for the design and construction of the FRA-70/71-13.10/14.36 (Projects 6A/6R) project in Columbus, Ohio. The projects represent the central portion of FRA-70-8.93 (PID 77369) I-70/71 south innerbelt improvements project, which includes all improvements along I-70 westbound from the I-71/SR-315 interchange to Front Street and along I-71 southbound from I-70 to Greenlawn Avenue. The FRA-71-14.36 (Project 6R) phase will consist of all work associated with the reconfiguration and construction of I-71 southbound from downtown (Front Street) to Greenlawn Avenue, including Ramps B3, C3, D6 and D7. This project includes the construction of two (2) new bridge structures, one (1) for I-71 southbound over Short Street, NS/CXS Railroad and the Scioto River (FRA-71-1503L) and one (1) for Ramp D7 over Short Street (FRA-70-1373B), as well as the construction of six (6) new retaining walls (Walls E4, E5, E7, E10 W2 and W5) to accommodate the new configuration. The FRA-70-13.10 (Project 6A) phase will consist of all work associated with the reconfiguration and construction of I-70 westbound from downtown (High Street) to SR-315, including Ramps D3N and D3W. This project includes the construction of one (1) new bridge structure for Ramp D3 over the Scioto River (FRA-70-1323C) and three (3) bridge replacements for I-70 westbound over the Scioto River (FRA-70-1322L), NS/CXS Railroad (FRA-70-1358L) and Short Street (FRA-70-1373L), as well as the construction of one (1) new retaining wall (Walls E3) to accommodate the new configuration. In addition, portions of the City of Columbus Streets, including W. Mound Street and Short Street, as well as a section of the Scioto Greenway Bike Path, will also be reconstructed during the various phases of construction.

This report is a presentation of the roadway exploration performed for the design and construction of the roadway alignments for the FRA-70-13.10 and FRA-71-14.36 Phases 6A and 6R in Franklin County, Ohio. It is understood that subgrade evaluation and stabilization will need to occur along the portions of the various roadway and ramp alignments where cuts or fills up to 3.0 feet are required. The alignments included in the various analyses are along I-70 westbound, I-71 southbound, Ramps B3, D6, D3N, D6, D7, W. Mound Street and Short Street. Proposed roadway construction along the associated roadways is shown on the vicinity map and boring plan presented in Appendix I. Areas in which the proposed subgrade is within 3.0 feet of the existing grade have been analyzed for subgrade recommendations.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Site Geology

Both the Illinoian and Wisconsinan glaciers advanced over two-thirds of the State of Ohio, leaving behind glacial features such as moraines, kame deposits, lacustrine deposits and outwash terraces. The glacial and non-glacial regions comprise five

physiographic sections based on geological age, depositional process and geomorphic occurrence (physical features or landforms). The project area lies within the Columbus Lowland District of the Till Plains Section. This area is characterized by flat to gently rolling ground moraine deposits from the Late Wisconsinan age. The site topography exhibits moderate to high relief. The ground moraine deposits are composed primarily of silty loam till (Darby, Bellefontaine, Centerburg, Grand Lake, Arcanum, Knightstown Tills), with smaller alluvium and outwash deposits bordering the Scioto River, its tributaries and floodplain areas. A ground moraine is the sheet of debris left after the steady retreat of glacial ice. The debris left behind ranges in composition from clay size particles to boulders (including silt, sand, and gravel). Outwash deposits consist of undifferentiated sand and gravel deposited by meltwater in front of glacial ice, and often occurs as valley terraces or low plains. Alluvium and alluvial terrace deposits range in composition from silty clay size particles to cobbles, usually deposited in present and former floodplain areas.

According to the bedrock geology and topography maps obtained from the Ohio Department of Natural Resources (ODNR), the underlying bedrock consists predominantly of the Middle to Lower Devonian-aged Columbus Limestone Formation. This formation is further subdivided into two members in the central portion of the state, known as the Delhi and Bellepoint Members. The Delhi Member consists of light gray, finely to coarsely crystalline, irregularly bedded, fossiliferous limestone. The Bellepoint Member consists of variable brown, finely crystalline, massively bedded limy dolomite. Both of these members contain chert nodules. Just east of Scioto River, the Upper Devonian Ohio Shale Formation overlies the Columbus Limestone Formation. The Ohio Shale formation consists of brownish black to greenish gray, thinly bedded, fissile, carbonaceous shale. Regionally, the bedrock surface forms a broad valley aligned roughly north-to-south beneath the Scioto River. According to bedrock topography mapping, the elevation of the bedrock surface ranges from roughly 600 feet mean sea level (msl) in the valley to roughly 625 feet msl near the project limits. Bedrock consisting primarily of shale overlying limestone was encountered in the borings performed for this structure at elevations ranging from 644.0 to 661.1 feet msl.

2.2. Existing Conditions

The project alignment is along the I-70/71 south innerbelt, primarily along I-70 westbound between SR-315 and High Street and along I-71 southbound between Greenlawn Avenue and I-70. The I-71, SR-315 and I-70 interchange is a major interchange with many entrance and exit ramps that connect the various alignments. I-70 crosses over the Scioto River just east of the I-71 and SR-315 interchange, with three existing bridges that cross the river and converge at the eastern bank into an eight-lane roadway. The roadway then reduces to a six-lane expressway which continues into downtown Columbus and crosses under Front Street and High Street. The existing I-70 is elevated from the surrounding terrain from east of the Scioto River to just west of Front Street and there are existing overpass bridges where the roadway crosses the existing CSX and Norfolk Southern Railroads and Short Street. The roadway profile is lowered from the surrounding terrain where the alignment enters into

downtown from just west of Front Street to the end of the project alignment. There is also an entrance ramp from Mound Street to I-70 westbound and an exit ramp from I-70 eastbound to Fulton Street and Livingston Avenue, which is where the existing eight-lane alignment transitions to six lanes. The daily traffic volume along the project alignment is very high. The alignment traverses primarily commercial and government properties. The surrounding terrain across the site is relatively flat-lying, with general slope toward the Scioto River.

3. EXPLORATION

Between July 16, 2013, and January 22, 2020, nineteen (19) soil borings, designated as B-020-2-13 through B-115-1-13, were advanced to completion depths ranging from 7.2 to 102.0 feet below the existing ground surface along the various alignments. In addition to the borings performed by Rii as part of the current exploration, twelve (12) soil borings, designated as B-025-0-08 through B-115-0-09, were performed by DLZ along the various alignments as part of the FRA-70-8.93 preliminary exploration (PID 77369), and their findings were published in a reports dated January and May, 2010. The borings were advanced to a completion depths ranging from 7.0 to 59.3 feet below the existing ground surface. The boring locations are shown on the boring plan provided in Appendix I of this report and summarized in Table 1 below.

Table 1. Test Boring Summary

Boring Number	Station	Offset	Alignment	Latitude	Longitude	Ground [1] Elevation (feet msl)	Boring Depth (feet)
B-020-2-13	176+13.92	34.0' RT	BL I-70 EB	39.953156	-83.004535	711.4	84.5
B-020-4-13	7007+77.61	12.0' RT	BL Ramp D7	39.954037	-83.004709	714.0	94.7
B-020-6-13	7008+36.29	24.1' RT	BL Ramp D7	39.954069	-83.004499	714.1	95.0
B-020-7-13	176+68.64	1.8' RT	BL I-70 WB	39.953452	-83.004377	713.5	80.4
B-020-8-13	7010+15.89	30.7' RT	BL Ramp D7	39.954179	-83.003900	721.0	102.0
B-020-9-15	5081+05.25	39.8' RT	BL Ramp C5	39.952887	-83.004333	713.0	75.5
B-021-3-13	7011+57.17	20.9' RT	BL Ramp D7	39.954262	-83.003407	727.0	34.4
B-023-2-13	7012+73.67	45.0' RT	BL Ramp D7	39.954244	-83.002984	733.1	25.0
B-024-2-14	5086+86.08	34.9' LT	BL Ramp C5	39.953083	-83.002321	742.7	59.2
B-025-0-08	5088+53.62	76.0' LT	BL Ramp C5	39.953359	-83.001796	740.4	59.3
B-026-3-13	5091+04.93	11.5' LT	BL Ramp C5	39.953297	-83.000849	756.9	90.0
B-026-4-19	185+64.16	3.7' RT	BL I-70 WB	39.953161	-83.001205	735.9	8.2
B-027-2-19	189+00.00	10' LT	BL I-70 WB	39.953130	-83.000009	729.6	7.9
B-028-0-08	191+29.78	14.9' LT	BL I-70 WB	39.953161	-82.999193	731.7	10.0
B-029-1-19	193+00.00	10' LT	BL I-70 WB	39.953187	-82.998590	735.7	7.9

Boring Number	Station	Offset	Alignment	Latitude	Longitude	Ground [1] Elevation (feet msl)	Boring Depth (feet)
B-091-0-09	3000+68.95	10.2' LT	BL Ramp B3	39.939735	-83.010418	705.2	7.0
B-092-0-09	685+49.50	79.6' LT	BL I-71 NB	39.940220	-83.010334	724.9	50.0
B-094-0-09	3003+86.72	8.6' LT	BL RAMP B3	39.940541	-83.010842	713.4	12.5
B-095-0-09	203+05.61	121.3' RT	BL I-71 NB	39.941330	-83.010689	718.0	10.0
B-096-1-09	206+96.35	14.0' RT	BL I-71 NB	39.942134	-83.011688	713.8	10.0
B-097-0-09	210+75.17	143.2' RT	BL I-71 NB	39.943216	-83.011905	720.2	15.0
B-098-1-09	214+88.38	15.1' RT	BL I-71 NB	39.944064	-83.012986	718.6	10.0
B-099-0-09	218+98.88	143.2' RT	BL I-71 NB	39.945227	-83.013250	722.1	20.0
B-099-4-14	221+70.29	44.7' RT	BL I-71 SB	39.945765	-83.014005	717.0	15.0
B-100-0-09	222+98.38	5.9' RT	BL I-71 NB	39.946029	-83.014338	716.6	15.0
B-113-2-13	245+03.67	17.9' LT	BL I-71 SB	39.951551	-83.015294	743.3	99.2
B-113-3-13	247+30.17	35.7' RT	BL I-71 SB	39.951860	-83.014577	735.3	91.0
B-114-7-13	271+12.84	28.4' RT	BL I-71 SB	39.953782	-83.006602	713.3	84.0
B-114-8-13	273+13.25	16.5' LT	BL I-71 SB	39.953894	-83.005886	714.0	82.0
B-115-0-09	833+32.42	17.8' RT	BL Trans Ramp D3N	39.952060	-83.016850	711.2	25.0
B-115-1-13	276+68.11	2.0' RT	BL I-71 SB	39.953729	-83.004634	714.6	75.5

The locations for the current exploration borings performed by Rii were determined and located in the field by Rii representatives. Rii utilized a handheld GPS unit to obtain geographic latitude and longitude coordinates of the boring locations. Ground surface elevations at the boring locations were interpolated using topographic mapping information provided by GPD Group and ms consultants.

The borings performed by Rii and Stock Drilling for the current exploration were drilled using a truck, all-terrain vehicle (ATV) or track mounted rotary drilling machine, utilizing either a 3.25 or 4.25-inch inside diameter, hollow stem auger to advance the holes. The borings performed by DLZ were drilled using a truck mounted rotary drilling machine, utilizing a 3.25-inch inside diameter, hollow stem to advance the holes. In general, standard penetration test (SPT) and split spoon sampling were performed in the borings at continuously or at 2.5-foot increments of depth within the upper 20.0 or 30.0 feet of the borings, and at 5.0-foot increments thereafter to the boring termination depths.

The SPT, per the American Society for Testing and Materials (ASTM) designation D1586, is conducted using a 140-pound hammer falling 30.0 inches to drive a 2.0-inch outside diameter split spoon sampler 18.0 inches. DLZ and Rii utilized a calibrated automatic drop hammer to generate consistent energy transfer to the sampler. Driving

resistance is recorded on the boring logs in terms of blow per 6.0-inch interval of the driving distance. The second and third intervals are added to obtain the number of blows per foot (N). Standard penetration blow counts aid in determining soil properties applicable in pavement subgrade design. Measured blow count (N) values are corrected to an equivalent (60%) energy ratio, N_{60}, by the following equation. Both values are represented on boring logs in Appendix III.

$$N_{60} = N_m*(ER/60)$$

Where:
N_m = measured N value
ER = drill rod energy ratio, expressed as a percent, for the system used

The automatic hammers for the Mobile B-53, CME 55, CME 75 and CME 750X drill rigs have drill rod energy ratios of 77.9, 85.9, 84.0 and 84.2 percent, respectively.

The hammers for the Mobile B-53 and CME 750 drill rigs operated by Rii were calibrated on April 26, 2013, and have drill rod energy ratios of 77.7 and 82.6 percent, respectively. The hammer for the CME 750X drill rig operated by Rii was calibrated on October 20, 2014, and has a drill rod energy ratio of 85.7 percent. This rig was subsequently recalibrated on September 3, 2018, with an updated drill rod energy ratio of 79.5 percent. The hammer for the CME 55 drill rig operated by Rii was calibrated on October 20, 2014, and has a drill rod energy ratio of 92.0 percent. The hammers for the BK 81 HD and CME 55-LC drill rigs operated by Stock Drilling were calibrated on March 28, 2013, and have drill rod energy ratios of 72.3 and 73.2 percent, respectively. The hammers for the CME 75 drill rigs operated by DLZ have drill rod energy ratios of 61 and 63 percent, respectively. No calibration date is available for the DLZ rig calibrations.

Hand penetrometer readings, which provide a rough estimate of the unconfined compressive strength of the soil, were reported on the boring logs in units of tons per square foot (tsf) and were utilized to classify the consistency of the cohesive soil in each layer. An indirect estimate of the compressive strength of the cohesive split spoon samples can also be made from a correlation with the blow counts (N_{60}). Please note that split spoon samples are considered disturbed and the laboratory determination of their shear strengths may vary from undisturbed conditions.

At the completion of drilling, the borings were backfilled with a mixture of bentonite chips and soil cuttings generated during the drilling process, or sealed with a cement-bentonite grout in accordance with ODOT specifications. For borings performed within the existing roadway, the pavement was patched with either an equivalent thickness of quick set concrete or cold asphalt.

During drilling for the borings performed by Rii, field logs were prepared by Rii personnel showing the encountered subsurface conditions. Soil samples obtained from the drilling operation were preserved and sealed in glass jars and delivered to the soil laboratory. In the laboratory, the soil samples were visually classified and select samples were tested, as noted in Table 2.

Table 2. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed
Natural Moisture Content	AASHTO T265	285
Plastic and Liquid Limits	AASHTO T89, T90	110
Gradation – Sieve/Hydrometer	AASHTO T88	110
Sulfate Content Testing	ODOT 1122	3
One-Dimensional Consolidation	ASTM D2435	2
Consolidated Undrained (CU) Triaxial Test	ASTM D4767	1
Unconfined Compressive Strength of Intact Rock	ASTM D7012	13
Point Load Strength Index of Rock Specimens	ASTM D5731	1

The tests performed are necessary to classify existing soil according to the Ohio Department of Transportation (ODOT) classification system and to estimate engineering properties of importance in determining foundation and roadway embankment design and construction recommendations. Results of the laboratory testing are presented on the boring logs in Appendix III. A description of the soil terms used throughout this report is presented in Appendix II.

The depth to competent bedrock was determined by auger and/or split spoon sampler refusal. Auger refusal is defined as no or insignificant observable advancement of the augers with the weight of the drill rig driving the augers. Split spoon sampler refusal is defined as exceeding 50 blows with less than 6.0 inches of penetration by the split spoon sampler.

Where the borings were extended into the competent bedrock or upon encountering auger refusal on large boulders, an NQ or HQ-sized double-tube diamond bit core barrel (utilizing wire line equipment) was used to core the bedrock. Coring produced 1.8 or 2.5 inch diameter cores, for NQ and HQ-sized cores, respectively, from which the type of rock and its geological characteristics were determined.

Rock cores were logged in the field and visually classified in the laboratory. They were analyzed to identify the type of rock, color, mineral content, bedding planes and other geological and mechanical features of interest in this project. The Rock Quality Designation (RQD) for each rock core run was calculated according to the following equation:

$$RQD = \frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \text{ x } 100$$

The RQD value aids in estimating the general quality of the rock and is used in conjunction with other parameters to designate the quality of the rock mass.

4. FINDINGS

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the respective version of the ODOT Specifications for Geotechnical Explorations (SGE) at the time the exploration borings were performed. The following is a summary of what was found in the test borings performed as part of the preliminary engineering phase and current exploration and what is represented on the boring logs

4.1. Surface Materials and Subsurface Soils

4.1.1. I-70 Westbound (Sta. 182+00 to End Project)

Borings B-024-2-14, B-025-0-08, B-026-4-19, B-027-2-19, B-028-0-08 and B-029-1-19 were drilled within the existing pavement or shoulders along I-70 westbound. Borings drilled within the existing mainline lanes encountered a composite pavement section consisting of 5.0 to 9.0 inches of asphalt overlying 8.0 to 13.0 inches of concrete followed by 6.0 to 8.0 inches of aggregate base. Borings within the existing shoulders encountered a flexible pavement section consisting of 7.0 to 12.0 inches of asphalt overlying 6.0 to 7.0 inches of aggregate base. Boring B-026-3-13 was performed within the existing sidewalk along the west side of S. Front Street, at the intersection with W. Fulton Street on the north side of I-70/I-71 and encountered 6.0 inches of concrete overlying 6.0 inches of aggregate base.

Beneath the surficial materials, material identified as existing fill consisting of hard, brown sandy silt (ODOT A-4a) was encountered to a depth of 3.5 feet below grade in boring B-025-0-08 and loose to very dense, brown and gray gravel with sand (ODOT A-1-b) was encountered to the boring termination depth of 10.0 feet below grade in boring B-028-0-08.

Underlying the surface materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils encountered were generally described as loose to very dense, brown, gray and brownish gray gravel, gravel with sand, gravel with sand and silt, coarse and fine sand, sandy silt and silt (ODOT A-1-a, A-1-b, A-2-4, A-3a, A-4a, A-4b). The natural cohesive soils encountered were generally described as soft to hard, gray and brown sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

The relative density of granular soils is primarily derived from SPT blow counts (N_{60}). Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($5 < N_{60} < 10$ blows per foot [bpf]) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling ranged from 6 bpf to split spoon sampler refusal. The shear strength and consistency of the cohesive soils are primarily derived from the hand penetrometer values (HP). The cohesive soil encountered ranged from soft ($0.25 < HP \leq 0.5$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.5 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 3 to 30 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 9 percent below to 5 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to moderately above optimum moisture levels.

Sulfate testing was performed in accordance with the ODOT Supplement 1122 in the upper soils of the existing subgrade in borings B-026-4-19, B-027-2-19 and B-029-1-19, as outlined in the current ODOT Geotechnical Bulletin GB1: Plan Subgrades (GB1). Based on the results of the testing, the sulfate contents of the subgrade soils range from 310 to 3,800 parts per million (ppm or mg/kg of material). Results of the sulfate testing at each boring location tested are provided on the respective boring log in Appendix III.

4.1.2. I-71 Southbound (Begin Project to Sta. 221+10) and Ramp B3

Borings B-091-0-09 and B-094-0-09 were performed within the existing pavement of the ramp from I-71/SR-315 SB to Greenlawn Avenue and encountered 4.0 inches of asphalt overlying 8.0 inches of concrete and 9.0 inches of concrete overlying 6.0 inches of aggregate base at the ground surface, respectively. Borings B-092-0-09, B-095-0-09, B-096-1-09, B-097-0-09, B-098-0-09, B-099-0-09 and B-100-0-09 were drilling through the existing pavement or shoulders along I-71 northbound and southbound. Borings drilled within the existing mainline lanes encountered a composite pavement section consisting of 3.0 to 7.0 inches of asphalt overlying 9.0 to 10.0 inches of concrete followed by 6.0 inches of aggregate base. Borings performed within the existing shoulders encountered a flexible pavement section consisting of 5.0 to 8.0 inches of asphalt overlying 5.0 to 13.0 inches of aggregate base.

Beneath the surficial materials, material identified as existing fill was encountered in all of the borings extending to depths ranging from 3.5 to over 10.0 feet below grade. The existing fill was comprised of medium stiff to hard, brown and gray sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b) and loose to very dense, brown, gray and brownish gray gravel, gravel with sand and sandy silt (ODOT A-1-a, A-1-b, A-4a).

Underlying the surface materials and existing fill, natural soils were encountered consisting of both granular and cohesive material. The granular soils encountered were generally described as medium dense to very dense, brown and gray gravel, gravel with sand, and gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). The natural cohesive soils encountered were generally described as soft to hard, brown gray and black sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($5 < N_{60} < 10$ bpf) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling ranged from 2 bpf to split spoon sampler refusal. The cohesive soil encountered ranged from soft ($0.25 < HP \leq 0.5$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.5 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 3 to 35 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 10 percent below to 10 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to significantly above optimum moisture levels.

4.1.3. Ramp D3N

Borings B-113-3-13 and B-115-0-09 were performed within the existing pavement of the ramp from I-WB to SR-315 NB/Rich Street and encountered 5.0 to 6.0 inches of asphalt overlying 12.0 to 13.0 inches of aggregate base at the ground surface. Boring B-113-2-13 was drilled through the existing shoulder of I-70 westbound and encountered 8.0 inches of asphalt overlying 6.0 inches of aggregate base.

Beneath the surficial materials in borings B-113-3-13 and B-115-0-09, material identified as existing fill was encountered extending to a depth ranging from of 8.5 and 28.0 feet below grade. The existing fill was comprised of stiff to very stiff, brown and gray sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b) and medium dense to very dense, brown gravel with sand and silt and coarse and fine sand (ODOT A-2-4, A-3a).

Underlying the surface materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils encountered were generally described as loose to very dense, brown and brownish gray gravel, gravel with sand, gravel with sand and silt and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-3a). The natural cohesive soils encountered were generally described as stiff to hard, brown, gray and brownish gray sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b).

Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($5 < N_{60} < 10$ bpf) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling ranged from 7 bpf to split spoon sampler refusal. The cohesive soil encountered ranged from stiff ($1.0 < HP \leq 2.0$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.5 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 3 to 36 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 4 percent below to 6 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be moderately below to moderately above optimum moisture levels.

4.1.4. Short Street

Boring B-020-2-13 was drilled through existing pavement at the entry of the access drive and encountered 4.0 inches of asphalt overlying 6.0 inches of aggregate base. Boring B-020-6-13 was drilled through the existing sidewalk that runs along the south side of Mound Street, east of Short Street, and encountered 2.0 inches of concrete overlying 7.0 inches of aggregate base at the ground surface. Boring B-020-7-13 was drilled through the existing sidewalk along the east side of Short Street, below the existing bridge structure and between the curb and pier columns, and encountered 8.0 inches of concrete at the ground surface. Boring B-020-9-13 was drilled through the existing pavement of Short Street and encountered 4.0 inches of asphalt overlaying 4.0 inches of brick pavers followed by 3.0 inches of aggregate base at the ground surface. Borings B-020-4-13 and B-115-1-13 were performed in grass areas on the west and east side Short Street, respectively, and encountered 2.0 and 9.0 inches of topsoil at the ground surface.

Beneath the surficial materials, material identified as existing fill was encountered in all of the borings extending to depths ranging from 8.0 to 20.5 feet below grade. The existing fill was comprised of medium stiff to hard, brown, dark brown and black sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6) and very loose to medium dense, brown and dark brown gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

Underlying the surface materials and existing fill, natural soils were encountered consisting of both granular and cohesive material. The granular soils encountered were generally described as loose to very dense, brown, gray, brownish gray, dark gray and black gravel, gravel with sand, gravel with sand and silt, gravel with sand, silt and clay and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-2-6, A-3a). The natural cohesive soils encountered were generally described as stiff to hard, brown, gray and brownish gray sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

Based on the SPT blow counts obtained, the granular soil encountered ranged from very loose (N_{60} < 5 bpf) to very dense (N_{60} > 50 bpf). Overall blow counts recorded from the SPT sampling ranged from 4 bpf to split spoon sampler refusal. The cohesive soil encountered ranged from medium stiff (0.5 < HP ≤ 1.0 tsf) to hard (HP > 4.0 tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.75 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 2 to 37 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 5 percent below to 10 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be moderately below to significantly above optimum moisture levels.

4.1.5. Mound Street

Boring B-021-3-13 was drilled along the south side of Mound Street and encountered 3.0 inches of asphalt overlying 8.0 inches of concrete at the ground surface. Borings B-020-6-13 and B-020-8-13 were drilled through the existing sidewalk that runs along the south side of Mound Street, east of Short Street, and encountered 2.0 and 8.0 inches of concrete overlying 7.0 and 4.0 inches of aggregate base, respectively, at the ground surface. Boring B-020-4-13 was performed in a grass area between the sidewalk and pine trees at the southwest corner of the intersection of Mound Street and Short Street and encountered 2.0 inches of topsoil at the ground surface. Boring B-023-2-13 was drilled in grass area along the south side of Mound Street, between the entrance ramp to I-70 westbound and the AEP power substation, and encountered 11.0 inches of topsoil at the ground surface. Borings B-114-7-13 and B-114-8-13 were drilled in the grass on the south side of Mound Street and encountered 2.0 and 3.0 inches of topsoil at the ground surface.

Beneath the surficial materials, material identified as existing fill was encountered in all of the borings extending to depths ranging from 3.0 to 10.5 feet below grade. The existing fill was comprised of stiff to hard, brown and dark brown sandy silt and silt and clay (ODOT A-4a, A-6a) and loose to medium dense, brown gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

Underlying the surface materials and existing fill, natural soils were encountered consisting of both granular and cohesive material. The granular soils encountered were generally described as loose to very dense, brown, gray, dark brown and black gravel, gravel with sand, gravel with sand and silt, gravel with sand, silt and clay and coarse and fine sand (ODOT A-1-a, A-1-b, A-2-4, A-2-6, A-3a). The natural cohesive soils encountered were generally described as medium stiff to hard, brown, gray and dark brown sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($5 < N_{60} < 10$ bpf) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling ranged from 4 bpf to split spoon sampler refusal. The cohesive soil encountered ranged from medium stiff ($0.5 < HP \leq 1.0$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.75 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 1 to 30 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 8 percent below to 10 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to significantly above optimum moisture levels.

4.2. Bedrock

Bedrock was encountered in borings eleven (11) of the borings at depths ranging from 60.4 to 89.2 feet below the existing grade, corresponding to elevations ranging from 647.1 to 658.3 feet msl. Upon encountering the bedrock surface in these borings, a changeover to rock coring techniques was made. A summary of the top bedrock elevations encountered in each boring is provided in Table 3.

Table 3. Top of Bedrock Elevations

Boring Number	Ground Elevation (feet msl)	Top of Bedrock		Rock Description
		Depth (feet)	Elevation (feet msl)	
B-020-2-13	711.4	64.3	647.1	Shale over Limestone
B-020-4-13	714.0	64.4	649.6	Shale over Claystone over Limestone
B-020-6-13	714.1	60.4	653.7	Shale over Limestone
B-020-7-13	713.5	65.4	648.1	Mudstone
B-020-8-13	721.0	65.0	656.0	Mudstone over Shale over Limestone
B-020-9-15	713.0	60.5	652.5	Shale

Boring Number	Ground Elevation (feet msl)	Top of Bedrock		Rock Description
		Depth (feet)	Elevation (feet msl)	
B-113-2-13	743.3	89.2	654.1	Limestone
B-113-3-13	735.3	77.0	658.3	Shale over Limestone
B-114-7-13	713.3	64.9	648.4	Shale over Limestone
B-114-8-13	714.0	63.5	650.5	Shale over Claystone over Limestone
B-115-1-13	714.6	63.5	651.1	Mudstone

The cored bedrock across the subject site consisted of very weak to weak, gray, dark gray and black shale, claystone and mudstone overlying strong to very strong, gray, dark gray and brown limestone. It should be noted that bedrock experiences mechanical breaks during the drilling and coring processes. Rii attempted to account for fresh, manmade breaks during tabulation of the RQD analysis. In general, percent recoveries of the rock cores ranged from 20% to 100%, while RQD values ranged from 0% to 100%. The quality of the cored bedrock, according to the RQD value, ranged from very poor (RQD ≤ 25%) to very good (86 ≤ RQD ≤ 100%). The percent recovery, RQD values unconfined compressive strength of the bedrock core runs are summarized in Table 4.

Table 4. Rock Core Summary

Boring	Core No.	Depth (feet)	Recovery (%)	RQD (%)	Unconfined Compressive Strength
B-020-2-13	RC-1	69.5 to 74.5	40	8	N/A
	RC-2	74.5 to 79.5	20	0	N/A
	RC-3	79.5 to 84.5	97	97	N/A
B-020-4-13	RC-1	74.7 to 79.7	92	75	N/A
	RC-2	79.7 to 84.7	100	100	N/A
	RC-3	84.7 to 89.7	95	90	q_u @ 86.5’ = 13,130 psi
	RC-4	89.7 to 94.7	95	85	q_u @ 90.7’ = 16,178 psi

Boring	Core No.	Depth (feet)	Recovery (%)	RQD (%)	Unconfined Compressive Strength
B-020-6-13	RC-1	60.0 to 65.0	90	60	N/A
	RC-2	65.0 to 70.0	33	0	N/A
	RC-3	70.0 to 75.0	100	64	N/A
	RC-4	75.0 to 80.0	97	63	q_u @ 77.4' = 177 psi
	RC-5	80.0 to 85.0	83	57	N/A
	RC-6	85.0 to 90.0	100	89	N/A
	RC-7	90.0 to 95.0	100	100	q_u @ 91.5' = 12,531 psi
B-020-8-13	RC-1	65.0 to 67.0	52	33	N/A
	RC-2	67.0 to 72.0	97	72	q_u @ 71.2' = 275 psi
	RC-3	72.0 to 77.0	100	83	N/A
	RC-4	77.0 to 82.0	90	68	N/A
	RC-5	82.0 to 87.0	95	78	q_u @ 85.9' = 318 psi
	RC-6	87.0 to 92.0	52	8	N/A
	RC-7	92.0 to 97.0	100	100	N/A
	RC-8	97.0 to 102.0	100	100	q_u @ 97.1' = 4,737 psi
B-020-7-13	RC-4	65.4 to 75.4	97	89	q_u @ 69.4' = 224 psi [1]
	RC-5	75.4 to 80.4	100	45	N/A
B-020-9-13	RC-1	60.5 to 65.5	52	17	N/A
	RC-2	65.5 to 70.5	75	48	N/A
	RC-3	70.5 to 75.5	100	80	N/A
B-113-2-13	RC-1	89.2 to 94.2	85	84	q_u @ 91.5' = 14,395 psi
	RC-2	94.2 to 99.2	97	97	N/A
B-113-3-13	RC-1	81.0 to 86.0	98	98	N/A
	RC-2	86.0 to 91.0	92	87	q_u @ 87.8' = 5,882 psi
B-114-7-13	RC-1	74.0 to 79.0	92	48	q_u @ 75.1' = 8,488 psi
	RC-2	79.0 to 84.0	83	52	q_u @ 81.5' = 9,141 psi
B-114-8-13	RC-1	67.0 to 72.0	82	19	N/A
	RC-2	72.0 to 77.0	97	12	q_u @ 74.8' = 92 psi
	RC-3	77.0 to 82.0	98	92	q_u @ 78.4' = 12,567 psi

Boring	Core No.	Depth (feet)	Recovery (%)	RQD (%)	Unconfined Compressive Strength
B-115-1-13	RC-1	63.5 to 65.5	100	100	N/A
	RC-2	65.5 to 70.5	95	40	N/A
	RC-3	70.5 to 75.5	96	87	N/A

1. Indicates unconfined compressive strength determined from point load testing.

4.3. Groundwater

Groundwater was encountered in the borings as presented in Table 5.

Table 5. Groundwater Levels

Boring Number	Ground Surface Elevation (feet msl)	Initial Groundwater		Upon Completion [1]	
		Depth (feet)	Elevation (feet msl)	Depth (feet)	Elevation (feet msl)
B-020-2-13	711.4	18.5	692.9	N/A	N/A
B-020-4-13	714.0	18.5	695.5	N/A	N/A
B-020-6-13	714.1	26.0	688.1	N/A	N/A
B-020-7-13	713.5	N/A [2]	N/A	N/A	N/A
B-020-8-13	721.0	18.5	702.5	N/A	N/A
B-020-9-15	713.0	24.5	688.5	N/A	N/A
B-021-3-13	727.0	21.0	706.0	N/A	N/A
B-023-2-13	733.1	13.5	719.6	N/A	N/A
B-024-2-14	742.7	26.0	716.7	N/A	N/A
B-025-0-08	740.4	26.0	714.4	39.0	701.4
B-026-3-13	756.9	36.0	720.9	N/A	N/A
B-026-4-19	735.9	Dry	-	Dry	-
B-027-2-19	729.6	Dry	-	Dry	-
B-028-0-08	731.7	Dry	-	Dry	-
B-029-1-19	735.7	Dry	-	Dry	-
B-091-0-09	705.2	Dry	-	Dry	-
B-092-0-09	724.9	38.5	686.4	37.1	687.8
B-094-0-09	713.4	Dry	-	Dry	-
B-095-0-09	718.0	Dry	-	Dry	-

Boring Number	Ground Surface Elevation (feet msl)	Initial Groundwater		Upon Completion [1]	
		Depth (feet)	Elevation (feet msl)	Depth (feet)	Elevation (feet msl)
B-096-1-09	713.8	Dry	-	Dry	-
B-097-0-09	720.2	Dry	-	Dry	-
B-098-1-09	718.6	Dry	-	Dry	-
B-099-0-09	722.1	Dry	-	Dry	-
B-099-4-14	717.0	Dry	-	Dry	-
B-100-0-09	716.6	3.0	713.6	13.4	703.2
B-113-2-13	743.3	55.0	688.3	N/A	N/A
B-113-3-13	735.3	60.0	675.3	N/A	N/A
B-114-7-13	713.3	17.0	696.3	N/A	N/A
B-114-8-13	714.0	18.5	695.5	N/A	N/A
B-115-0-09	711.2	Dry	-	Dry	-
B-115-1-13	714.6	29.0	685.6	N/A	N/A

1. *Where N/A is listed, the groundwater level at completion could not be obtained due to the addition of water or mud as a drilling fluid.*
2. *Groundwater was not encountered in boring B-020-7-13 prior to introducing water to the borehole*

Groundwater was encountered initially during the drilling process in seventeen (17) of the borings at depths ranging from 3.0 to 60.0 feet below the existing ground surface, which corresponds to elevations ranging from 675.3 to 720.9 feet msl. Groundwater was not encountered in boring B-020-7-13 prior to introducing water to the borehole. At the completion of drilling and prior to removing the augers, groundwater was encountered in the auger stem of borings B-025-0-08, B-092-0-09 and B-100-0-09 at the depth of 39.0, 37.1 and 13.4 feet below grade, which corresponds to elevations 701.4, 687.8 and 703.2 feet msl, respectively. The groundwater at completion in the remaining borings where groundwater was initially encountered was not obtained due to the addition of water or mud as a drilling fluid. The remaining thirteen (13) borings were observed dry, meaning that no measurable amount of water was observed during or at the completion of drilling.

Please note that short-term water level readings, especially in cohesive soils, are not necessarily an accurate indication of the actual groundwater level. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation.

A more comprehensive description of what was encountered during the drilling process may be found on the boring logs in Appendix III.

5. ANALYSES AND RECOMMENDATIONS

Data obtained from the drilling and testing program have been used to determine pavement support capabilities for the soils encountered at the site. These parameters have been used to provide guidelines for the design of the pavement system, as well as the construction specifications related to the placement of the pavement and general earthwork recommendations, which is discussed in the following paragraphs.

5.1. Subgrade Recommendations

It is understood that subgrade evaluation and stabilization will need to occur along the portions of the various roadway and ramp alignments where cuts are required or where fills up to 3.0 feet are required. Based on a review of the plan information provided, the following alignments will require subgrade stabilization:

- I-70 WB – Sta. 182+00 to End Project
- I-71 SB – Begin Project to Sta. 221+10
- Ramp B3 – Entire Alignment
- Ramp D3N – Entire Alignment
- Ramp D6 – Sta. 6003+50 to End Alignment
- Ramp D7 – Sta. 7012+35 to End Alignment
- W. Mound Street – Entire Alignment
- Short Street – Entire Alignment
- Side Streets: Civic Center Drive, Jewett Street, Second Street, Ludlow Street – Entire Alignments

Soil borings within the vicinity of these alignments that contain subgrade information within 3.0 feet of the proposed grade along the alignments noted above were used in the subgrade analyses performed. All subgrade analyses were performed in accordance with the current version of Geotechnical Bulletin GB-1: Plan Subgrades, and outputs for the GB-1 analyses completed for the various alignments are presented in Appendix V.

The moisture content of cohesive soil has a significant effect on the physical properties of the material. It must be noted that the moisture contents illustrated on the boring logs and utilized in this analysis represent the conditions during the drilling phase of the project. The referenced borings for subgrade analysis were drilled between September 2009 and January 2020. These soil conditions, especially in the surficial soils, may not coincide with the soil conditions that will be encountered during construction. Consequently, the extent/need for subgrade improvement is entirely dependent on the subgrade conditions (i.e., moisture contents) encountered at the time of construction.

Per GB-1 requirements, recommendations shall be provided for station-by-station and global stabilization options. However, it is also stated that "For all Interstates and other divided highways with four or more lanes more than 1-mile in project length, the subgrade of the entire project shall be chemically stabilized (global stabilization)." Given the overall size of the project, it is understood and recommended that global stabilization of the subgrade shall be performed using chemical stabilization where possible, or undercut and replacement in conjunction with geogrid where shallow utilities are located. Therefore, only global stabilization options are provided for the various alignments.

Per ODOT GB1 requirements, where global stabilization is performed, the entire subgrade should be stabilized, and pavement design should be performed using the average site parameters provided for each alignment. Upon completion of the stabilization, the entire subgrade should be proof rolled to verify that stability has been achieved.

Please note that the recommended CBR values assume that the materials utilized for the roadway subgrade in fill areas are equivalent to, or better than materials at the existing subgrade elevation. Sources of borrow material should be designated in advance of construction. The material should be tested in the laboratory to verify the soil exhibits the minimum design CBR value for the respective alignments.

Pavement design is dependent on the inclusion of adequate surface and subsurface drainage in order to maintain the compacted subgrade near optimum moisture conditions throughout the lifetime of the pavement. If underdrain systems are considered, they should be installed in accordance to the specifications presented in Item 204 of the ODOT Construction and Materials Specifications (CMS).

5.2.1. I-70 Westbound (Sta. 182+00 to End Project)

Seven (7) borings were utilized in the analysis of the subgrade along I-70 westbound between Sta. 182+00 to the end project alignment. The subgrade soils along the alignment consisted of both granular and cohesive soils. The granular soils encountered were comprised of loose to dense gravel, gravel with sand, and coarse and fine sand (ODOT A-1-a, A-1-b, A-3a). The cohesive soils encountered were comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 6 to 12 with an average of 9. **It is recommended that pavement design be based on the CBR value of 9** with a corresponding resilient modulus, M_R, of 10,800 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 190 pci and a soil support value (SSV) of 5.7.

Table 6. Average Site Parameters (I-70 WB)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
22	6	8	8	3	9

It is recommended that the subgrade along the alignment for the final FRA-70-13.10 Project 6A configuration be chemically stabilized with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.

In addition, per ODOT GB1, soils with sulfate content in excess of 5,000 ppm cannot be chemically stabilized due to the potential for sulfate heave in the soil. Based on the results of the testing, the sulfate contents of the subgrade soils range from 310 to 3,800 parts per million (ppm or mg/kg of material). Therefore, soil with a sulfate content greater than 5,000 ppm was not encountered in any of the borings.

Based on a review of the plan information provided, a portion of the subgrade will be stabilized as part of the first phase of construction as part of the FRA-71-14.36 Project 6R, which will include I-71 southbound from Sta. 282+50 to the end project alignment. The recommendations above should be utilized where pavement will not be replaced as part of the second phase of construction for the FRA-70-13.10 Project 6A.

Additionally, for areas of I-70 westbound that will have pavement replaced as part of the first phase of construction as part of the FRA-71-14.36 Project 6R, which will be subsequently replaced as part of the second phase of construction for FRA-70-13.10 Project 6A, it is recommended that subgrade be stabilized via excavate and replacement due to the amount of time that the pavement will be in services between the phases of construction. The subgrade for this area shall be stabilized via a 12-inch undercut and replacement with ODOT Item 703.16C granular material, Type B, C or D installed over ODOT Item 712.09 Geotextile Fabric, Type D as detailed in accordance with ODOT Item 204.

5.2.2. I-71 Southbound (Begin Project to Sta. 221+10) and Ramp B3

Seven (7) borings were utilized in the analysis of the subgrade along I-71 southbound between the begin project alignment and Sta. 221+10. The subgrade soils along the alignment consisted of both cohesive and granular soils. The cohesive soils encountered were comprised of medium stiff to very stiff sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The granular soils encountered were comprised of loose to medium dense gravel and gravel with sand (ODOT A-1-a, A-1-b).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 4 to 12 with an average of 8. **It is recommended that pavement design be based on the CBR value of 8** with a corresponding resilient modulus, M_R, of 9,600 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 175 pci and a soil support value (SSV) of 5.3.

Table 7. Average Site Parameters (I-71 SB)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
10	14	14	12	5	8

Five (5) borings were utilized in the analysis of the subgrade along Ramp B3. The subgrade soils along the alignment consisted of both cohesive and granular soils. The cohesive soils encountered were comprised of soft to very stiff sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b). The granular soils encountered were comprised of loose to medium dense gravel and gravel with sand (ODOT A-1-a, A-1-b).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 5 to 12 with an average of 8. **It is recommended that pavement design be based on the CBR value of 7** with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Table 8. Average Site Parameters (Ramp B3)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
13	16	17	12	7	7

It is recommended that the subgrade along the alignment of I-71 southbound between the begin project alignment and Sta. 221+10 and along the entire alignment of Ramp B3 be chemically stabilized with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.

Per direction from ODOT District 6, it is understood that sulfate testing has been performed along I-71 southbound within the project limits, and that chemical stabilization of a portion of the subgrade has been performed under a separate contract. Therefore, no additional sulfate testing was performed along I-71 southbound.

Based on a review of the plan and cross sections for Ramp B3, the ramp will be widened to the north to accommodate the proposed I-71 southbound lanes. This will result in the southern portion of the lane being within 3.0 feet of the existing grade, but the northern portion of the lane will be supported on more fill. To provide a uniform subgrade, it is recommended that the chemical stabilization be applied to the entire lane width plus an additional foot north of the lane or edge of pavement if the shoulders are being stabilized. It is not recommended to stabilize the select granular backfill within the limits of the MSE walls (Wall W2), so chemical stabilization should not overlap these areas.

5.2.3. Ramp D3N

Three (3) borings were utilized in the analysis of the subgrade along Ramp D3N. However, it should be noted that boring B-113-2-13 was located within the existing shoulder of I-71 westbound and may not be representative of the subgrade conditions along Ramp D3N. The subgrade soils along the alignment consisted of both cohesive and granular soils. The cohesive soils encountered were comprised of stiff to very stiff silt and clay and silty clay (ODOT A-6a, A-6b). The granular soils encountered were comprised of medium dense to very dense gravel with sand and coarse and fine sand (ODOT A-1-b, A-3a).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 4 to 12 with an average of 8. **It is recommended that pavement design be based on the CBR value of 7** with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Table 9. Average Site Parameters (Ramp D3N)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
16	16	13	11	7	7

It is recommended that the subgrade along the entire alignment of Ramp D3N be chemically stabilized with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils. Sulfate testing was not performed along this ramp alignment.

5.2.4. W. Mound Street, Short Street, Side Streets and Ramps D6/D7

Seven (7) borings were utilized in the analysis of the subgrade along W. Mound Street. However, it should be noted that only one boring, B-021-3-13, was drilled within the existing roadway along W. Mound Street, and that the remaining borings were drilled adjacent along the south side of the roadway within the grass or sidewalk. Therefore, these borings may not be representative of the subgrade conditions along W. Mound Street. The subgrade soils along the alignment consisted of both cohesive and granular soils. The cohesive soils encountered were comprised of stiff to very stiff sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6). The granular soils encountered were comprised of loose to medium dense gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 4 to 12 with an average of 8. **It is recommended that pavement design be based on the CBR value of 7** with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Table 10. Average Site Parameters (W. Mound Street)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
10	12	15	11	6	7

Six (6) borings were utilized in the analysis of the subgrade along Short Street. However, it should be noted that only one boring, B-020-9-15, was drilled within the existing roadway along Short Street, and that the remaining borings were drilled adjacent to the roadway within the grass, sidewalk or approach roadways. Therefore, these borings may not be representative of the subgrade conditions along Short Street. The subgrade soils along the alignment consisted of both cohesive and granular soils. The cohesive soils encountered were comprised of stiff sandy silt, silt and clay and silty clay (ODOT A-4a, A-6a, A-6b). The granular soils encountered were comprised of loose to medium dense gravel, gravel with sand and gravel with sand and silt (ODOT A-1-a, A-1-b, A-2-4).

Based on results of the GB-1 analysis of the subgrade soils, California Bearing Ratio (CBR) values (based on correlation charts) for the entire alignment ranged from 4 to 12 with an average of 8. **It is recommended that pavement design be based on the CBR value of 7** with a corresponding resilient modulus, M_R, of 8,400 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 165 pci and a soil support value (SSV) of 4.9.

Table 11. Average Site Parameters (Short Street)

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Average CBR
8	14	19	13	7	7

Analyses for Ramps D6 and D7 as well as the side streets (Civic Center Drive, Jewett Street, Second Street, Ludlow Street) were not performed due to the short length of the segments being replaced that would require subgrade stabilization. Therefore, the subgrade stabilization in these areas should follow the recommendations for W. Mound Street and Short Street, as outlined below.

Given the high density of utilities within both of these roadways, including multiple electrical duct banks and vaults as well as the Olentangy-Scioto Interceptor Sewer (OSIS), the use of chemical stabilization for these roadways is not preferred due to the potential of damaging the utilities or the reclaimer if it hits any of the buried utilities. Consideration was also given to the use of the use of 12-inches of excavate and replace for stabilization of the subgrade, but there are still concerns with potentially conflicting with a utility if this is utilized.

Based on discussions with the ODOT Office of Geotechnical Services (OGE), it was determined that the entire subgrade along the alignments of W. Mound Street and Short Street shall be stabilized via a 6-inch undercut and replacement in conjunction with geogrid. At the direction of ODOT OGE, Rii contacted a supplier to get a recommended stabilization design for this application. Santino Piccoli with TenCate Geosynthetics Americas provided a recommended stabilization design memorandum, which included design calculations as well as specifications, which are included in Appendix VI.

Per the recommendations provided by TenCate, the subgrade should be excavated 6.0-inches and a Mirafi RS580i geosynthetic reinforced geotextile shall be placed at the bottom of the excavation. Please note the material is classified as a geosynthetic reinforced geotextile, but should be installed in accordance with ODOT Item 204.07B (Geogrid) per the manufacturers specification. It is not recommended to proof roll the subgrade prior to placing the geosynthetic reinforced geotextile, as proof rolling may lead to disturbing or destabilizing the existing subgrade, or potentially damaging the existing shallow utilities. The excavation should be backfilled with 6.0 inches of ODOT Item 304 aggregate base. Per the design plans provided, the pavement section along both streets as well as the side streets and ramps include 6.0 inches of ODOT Item 304 as part of the design pavement section. Where ODOT Item 304 is included in the pavement section, it is recommended that this be placed at the same time as the 6.0 inches of ODOT Item 304 for the subgrade stabilization. It is further recommended that the total thickness of ODOT Item 304 be placed and compacted in a single lift. Proof rolling can then be performed on top of the compacted 304 material.

Following excavation of the subgrade for stabilization and prior to placing the geosynthetic reinforced geotextile, the manufacturer recommends that the existing subgrade be tested using a dynamic cone penetrometer (DCP). The DCP testing shall be performed in accordance with ASTM D6951/D6951M-09. Correlated CBR values shall be determined so that it can be confirmed that the design assumptions are valid. A sample plan note is provided in the design memorandum in Appendix VI. However, given the dense presence of utilities and granular soils along portions of the alignments, DCP testing may not be feasible. If DCP testing is deemed not feasible to perform, then consideration should be given to using a low weight deflectometer (LWD) to determine the existing subgrade strength.

5.2. Construction Considerations

All site work shall conform to local codes and to the latest ODOT Construction and Materials Specifications (CMS), including that all excavation and embankment preparation and construction should follow ODOT Item 200 (Earthwork).

Considerations should be given to the sequence of construction for the project, specifically with regards to the city streets. It is recommended that reconstruction of the city streets be performed at the end of the construction phase that it is included with to eliminate the potential of damaging the pavement or subgrade stabilization under the heavy construction traffic that will occur throughout the project. It is not recommended to operate any construction traffic on a stabilized subgrade, as this will lead to damage of the stabilization elements. At a minimum, the stabilized subgrade should be paved with base course of asphalt or concrete prior to operating construction traffic.

5.2.1. Excavation Considerations

All excavations should be shored / braced or laid back at a safe angle in accordance to Occupational Safety and Health Administration (OSHA) guidelines. During excavation, if slopes cannot be laid back to OSHA Standards due to adjacent structures or other obstructions, trench boxes or temporary shoring may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 12. Excavation Back Slopes

Soil	Maximum Back Slope	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None

5.2.2. Groundwater Considerations

Based on groundwater conditions encountered in the borings, groundwater is not anticipated to be encountered during construction of the roadway subgrade. However, where/if groundwater is encountered, proper groundwater control should be employed and maintained to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or "boiling" condition where soft silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36.0 inches below the deepest excavation. Any seepage or groundwater encountered at this site should be able to be controlled by pumping from temporary sumps. Additional measures may be required depending on seasonal fluctuations of the groundwater level. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6. LIMITATIONS OF STUDY

The above recommendations are predicated upon construction inspection by a qualified soil technician under the direct supervision of a professional geotechnical engineer. Adequate testing and inspection during construction are considered necessary to assure an adequate foundation system and are part of these recommendations.

The recommendations for this project were developed utilizing soil and bedrock information obtained from the test borings that were made at the proposed site for the current investigation. Resource International is not responsible for the data, conclusions, opinions or recommendations made by others during previous investigations at this site. At this time we would like to point out that soil borings only depict the soil and bedrock conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

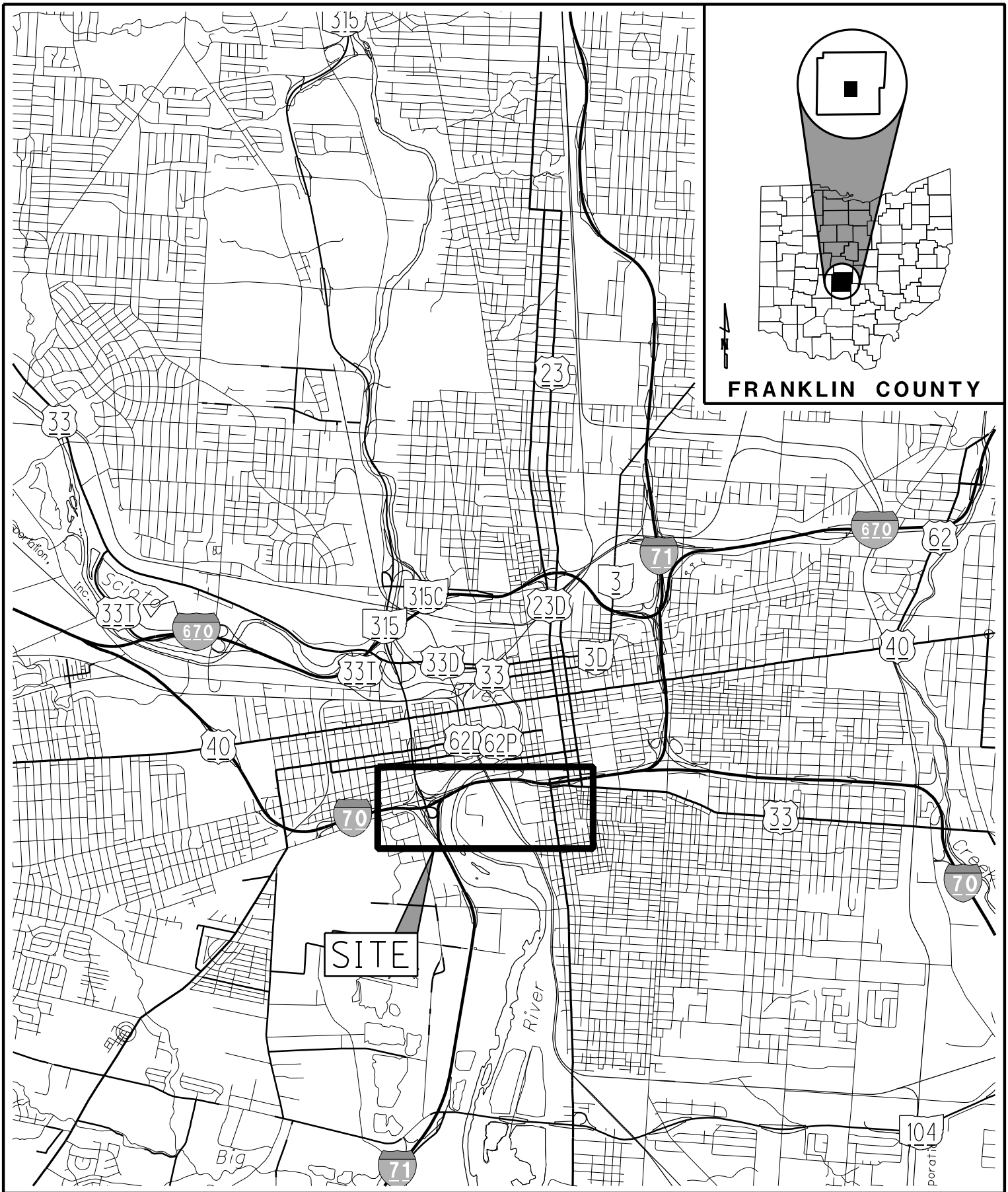
The conclusions and recommendations herein have been based upon the available soil and bedrock information and the design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the geotechnical engineer.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils or other unusual conditions observed are strictly for the information of our client.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. Resource International is not responsible for the conclusions, opinions or recommendations made by others based upon the data included.

APPENDIX I

VICINITY MAP AND BORING PLAN

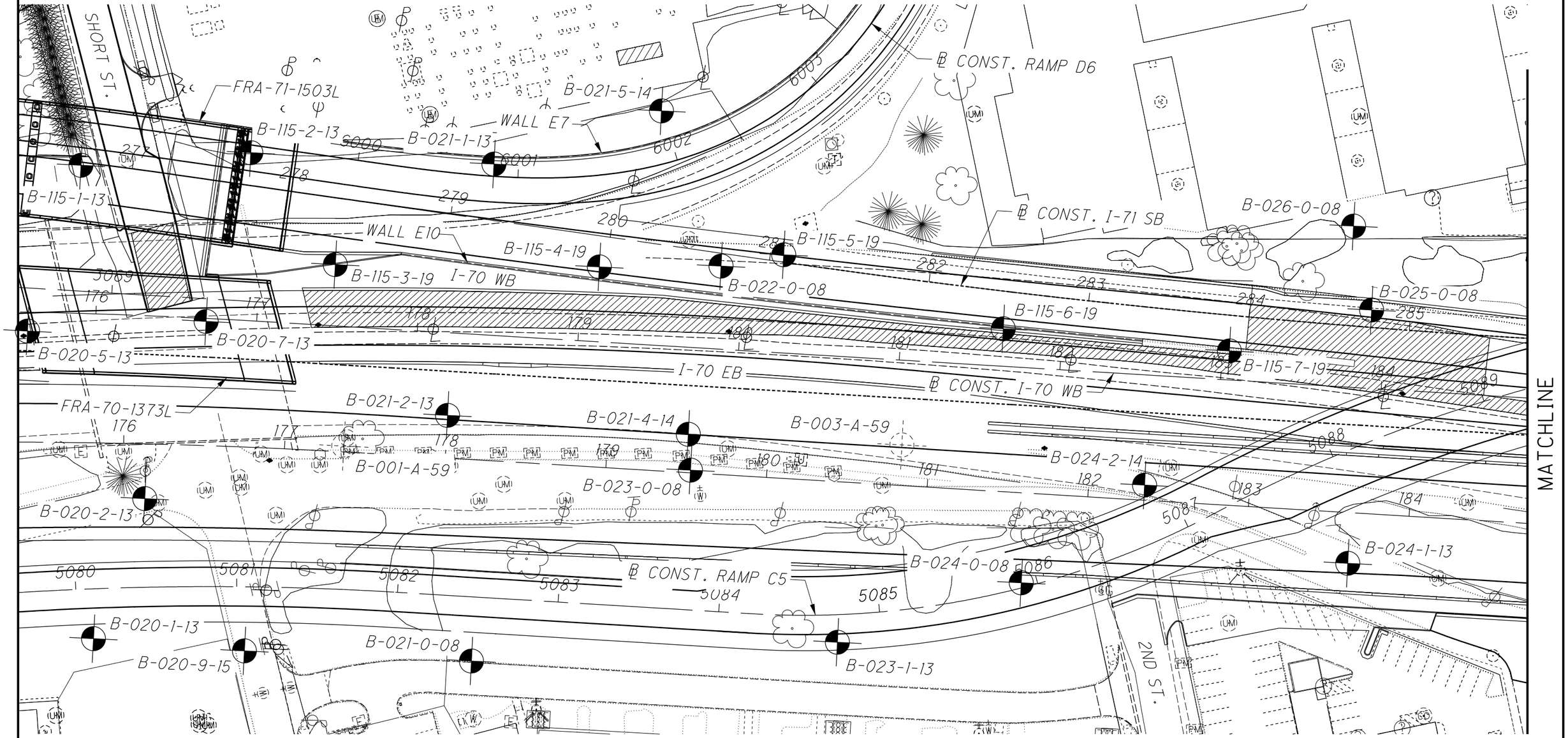


VICINITY MAP

FRA-70-13.10 AND FRA-71-14.36

COLUMBUS, OHIO

RII PROJECT NO. W-13-072	DRAWN RRM	RESOURCE INTERNATIONAL Rii
SCALE: 1"=5000' (0, 2500, 5000)	REVIEWED BRT	
	DATE 4-8-2020	

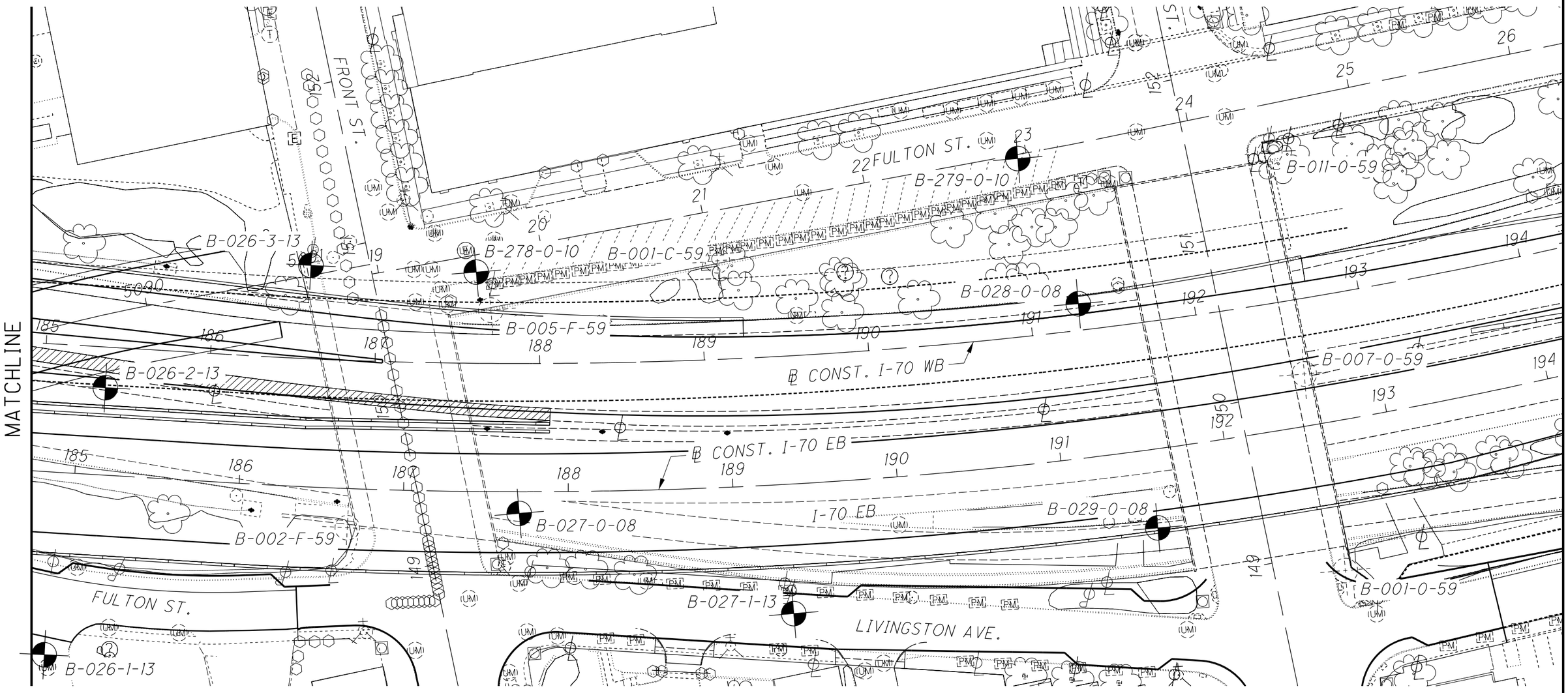


BORING PLAN

FRA-70/71-13.10/14.36 - I-70 WB AND I-71 SB
CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072		DRAWN RRM
SCALE: 1"=60' 0 30 60	N	REVIEWED BRT
		DATE 4-8-2020

RESOURCE INTERNATIONAL

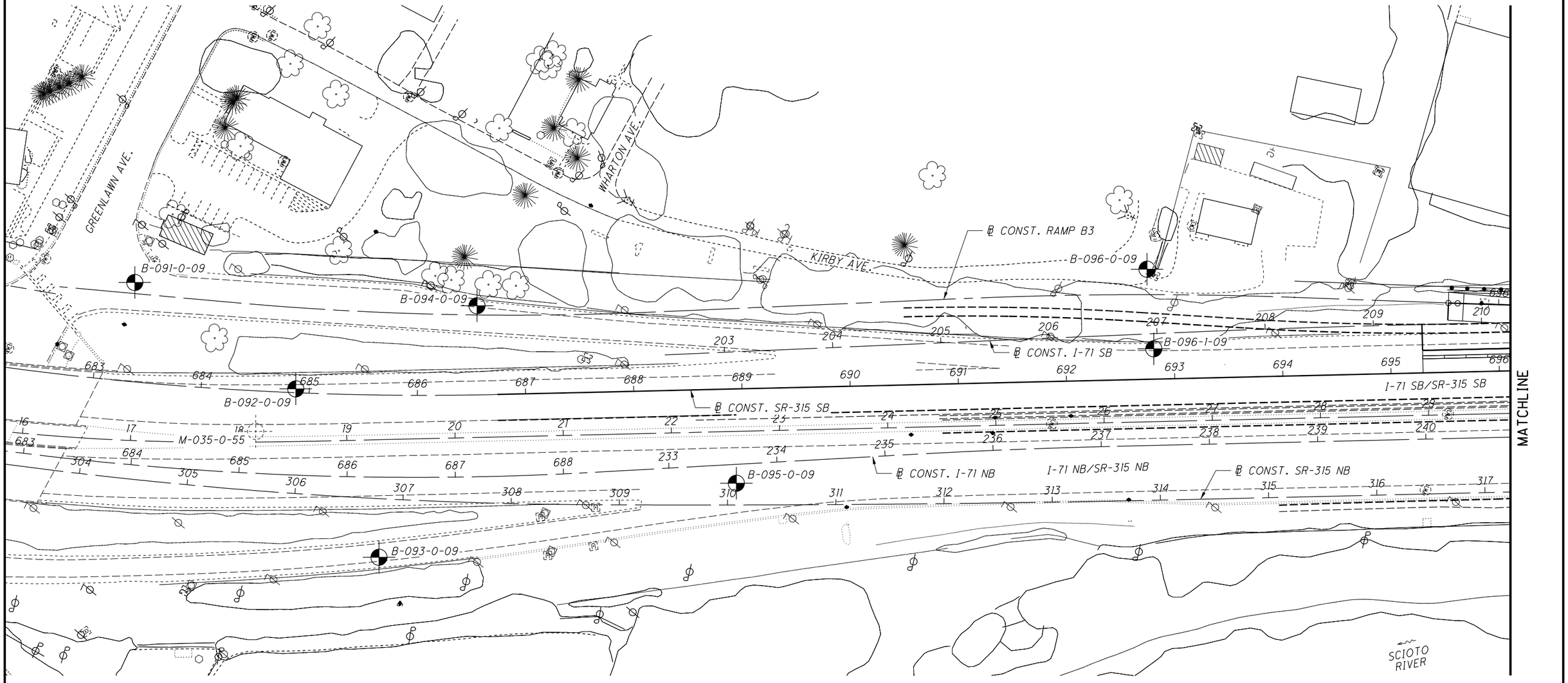


BORING PLAN

FRA-70/71-13.10/14.36 - I-70 WB AND I-71 SB
CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072		DRAWN RRM
SCALE: 1"=60' 0 30 60	N	REVIEWED BRT
		DATE 4-8-2020

RESOURCE INTERNATIONAL Rii

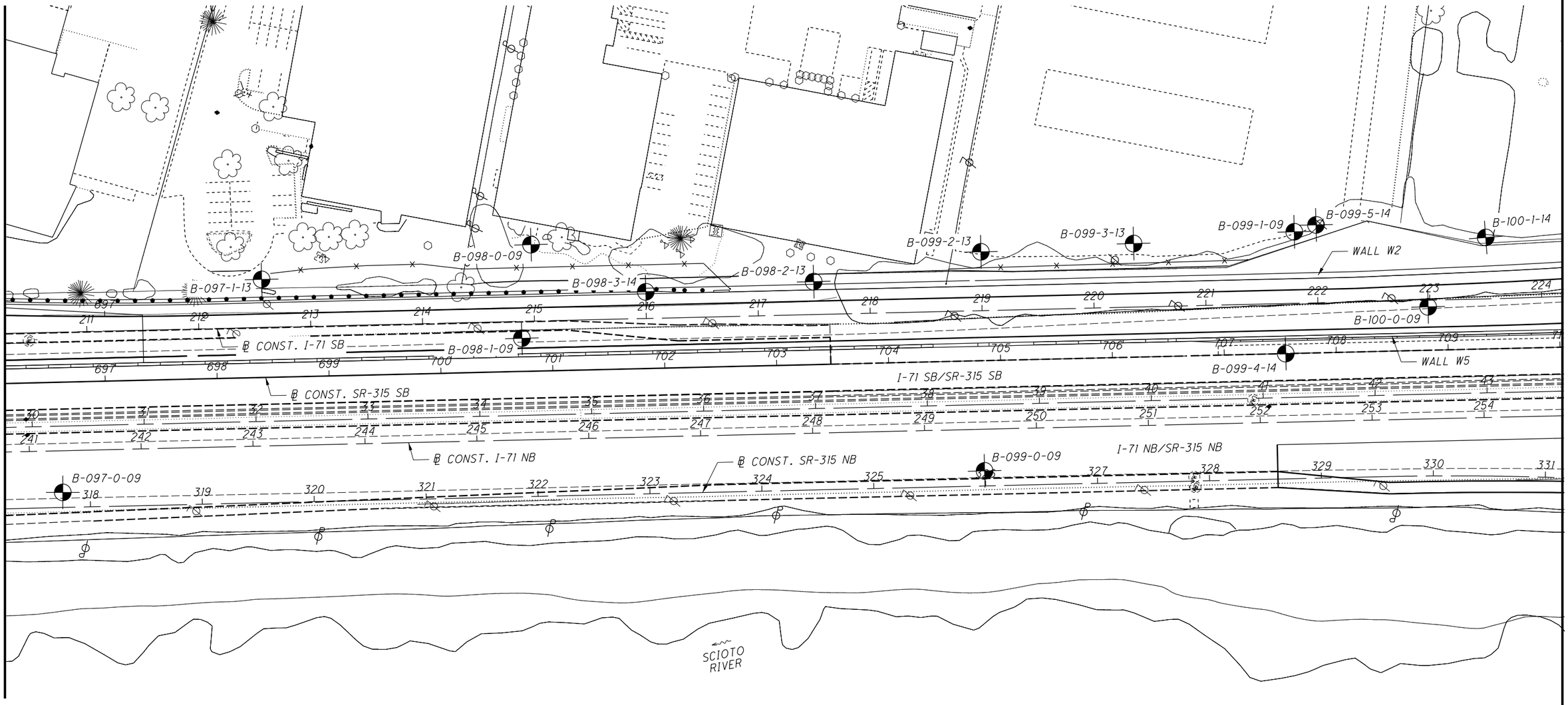


BORING PLAN

FRA-71-14.36 - RAMP B3 AND I-71 SB
CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072		DRAWN RRM
SCALE: 1"=90' 0 45 90		REVIEWED BRT
		DATE 4-8-2020

RESOURCE INTERNATIONAL Rii

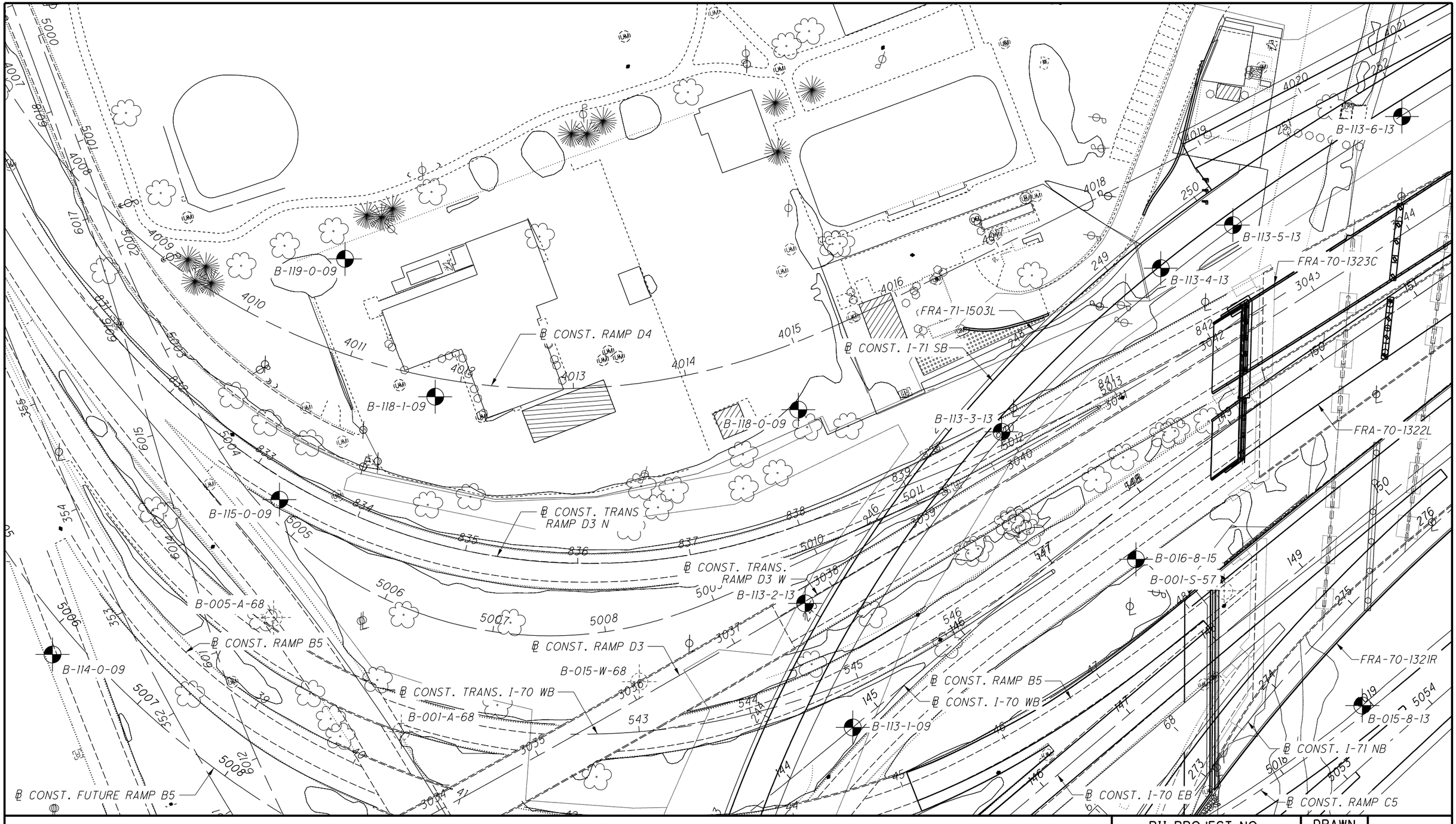


BORING PLAN

FRA-71-14.36 - RAMP B3 AND I-71 SB
CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072	DRAWN RRM
SCALE: 1"=90' (0 45 90)	REVIEWED BRT
	DATE 4-8-2020

RESOURCE INTERNATIONAL



BORING PLAN

FRA-70-13.10 - RAMP D3N

CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072		DRAWN RRM
SCALE: 1"=80' 0 40 80	N	REVIEWED BRT
		DATE 4-8-2020

RESOURCE INTERNATIONAL Rii

BORING PLAN

FRA-71-14.36 - MOUND ST.
CLARK COUNTY, OHIO

RII PROJECT NO. W-13-072	DRAWN RRM
SCALE: 1"=80' 0 40 80	REVIEWED BRT
N	DATE 4-8-2020

RESOURCE INTERNATIONAL Rii

℄ CONST. I-70 EB
B-019-2-13
WALL 4W8
WALL 4W9
℄ CONST. RAMP D3
B-114-9-13
℄ CONST. RAMP D7
B-020-1-13
B-020-0-08
B-020-5-13
FRA-70-1373R
FRA-70-1373L
B-020-2-13
B-115-1-13
℄ CONST. SHORT ST.
B-020-9-15
B-020-3-13
B-020-4-13
B-020-7-13
B-020-6-13
FRA-71-1503L
FRA-70-1373A
B-115-2-13
B-001-A-59
B-115-3-19
WALL 4W7
FRA-70-1373B
B-021-0-08
℄ CONST. I-71 SB
B-021-2-13
WALL 4W5
WALL 4W6
WALL E10
B-020-8-13
B-021-1-13
℄ CONST. RAMP C5
℄ CONST. I-70 WB
B-115-4-19

BORING PLAN

FRA-70/71-13.10/14.36 - I-70 WB AND I-71 SB
CLARK COUNTY, OHIO

RII PROJECT NO.
W-13-072

SCALE: 1"=60'
0 30 60

DRAWN
RRM

REVIEWED
BRT

DATE
4-8-2020

RESOURCE INTERNATIONAL
Rii

APPENDIX II

DESCRIPTION OF SOIL TERMS

DESCRIPTION OF SOIL TERMS

The following terminology was used to describe soils throughout this report and is generally adapted from ASTM 2487/2488 and ODOT Specifications for Geotechnical Explorations.

Granular Soils - The relative compactness of granular soils is described as:
ODOT A-1, A-2, A-3, A-4 (non-plastic) or USCS GW, GP, GM, GC, SW, SP, SM, SC, ML (non-plastic)

Description	Blows per foot – SPT (N_{60})		
Very Loose	Below		5
Loose	5	-	10
Medium Dense	11	-	30
Dense	31	-	50
Very Dense	Over		50

Cohesive Soils - The relative consistency of cohesive soils is described as:
ODOT A-4, A-5, A-6, A-7, A-8 or USCS ML, CL, OL, MH, CH, OH, PT

Description	Blows per foot – SPT (N_{60})			Unconfined Compression (tsf)
Very Soft	Below		2	UCS ≤ 0.25
Soft	2	-	4	0.25 < UCS ≤ 0.5
Medium Stiff	5	-	8	0.5 < UCS ≤ 1.0
Stiff	9	-	15	1.0 < UCS ≤ 2.0
Very Stiff	16	-	30	2.0 < UCS ≤ 4.0
Hard	Over		30	UCS > 4.0

Gradation - The following size-related denominations are used to describe soils:

Soil Fraction		USCS Size	ODOT Size
Boulders		Larger than 12”	Larger than 12”
Cobbles		12” to 3”	12” to 3”
Gravel	coarse	3” to ¾”	3” to ¾“
	fine	¾” to 4.75 mm (¾” to #4 Sieve)	¾” to 2.0 mm (¾” to #10 Sieve)
Sand	coarse	4.75 mm to 2.0 mm (#4 to #10 Sieve)	2.0 mm to 0.42 mm (#10 to #40 Sieve)
	medium	2.0 mm to 0.42 mm (#10 to #40 Sieve)	-
	fine	0.42 mm to 0.074 mm (#40 to #200 Sieve)	0.42 mm to 0.074 mm (#40 to #200 Sieve)
Silt		0.074 mm to 0.005 mm (#200 to 0.005 mm)	0.074 mm to 0.005 mm (#200 to 0.005 mm)
Clay		Smaller than 0.005 mm	Smaller than 0.005 mm

Modifiers of Components - Modifiers of components are as follows:

Term	Range		
Trace	0%	-	10%
Little	10%	-	20%
Some	20%	-	35%
And	35%	-	50%

Moisture Table - The following moisture-related denominations are used to describe cohesive soils:

Term	Range - USCS	Range - ODOT
Dry	0% to 10%	Well below Plastic Limit
Damp	>2% below Plastic Limit	Below Plastic Limit
Moist	2% below to 2% above Plastic Limit	Above PL to 3% below LL
Very Moist	>2% above Plastic Limit	
Wet	[3] Liquid Limit	3% below LL to above LL

Organic Content – The following terms are used to describe organic soils:

Term	Organic Content (%)
Slightly organic	2-4
Moderately organic	4-10
Highly organic	>10

Bedrock – The following terms are used to describe bedrock hardness:

Term		Blows per foot – SPT (N)		
Very Soft		Below		50
Soft		50/5”	–	50/6”
Medium Hard		50/3”	–	50/4”
Hard		50/1”	–	50/2”
Very Hard	50/0”			

DESCRIPTION OF ROCK TERMS

The following terminology was used to describe the rock throughout this report and is generally adapted from ASTM D5878.

Weathering – Describes the degree of weathering of the rock mass:

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alteration of the rock mass. Mineral crystals have a right appearance with no discoloration. Fractures show little or not staining on surfaces.
Slightly Weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately Weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly Weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely Weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present but the material can generally be molded and crumbled by hand pressures.

Strength of Bedrock – The following terms are used to describe the relative strength of bedrock:

Description	Field Parameter
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

Bedding Thickness – Description of bedding thickness as the average perpendicular distances between bedding surfaces:

Description	Thickness
Very Thick	Greater than 36 inches
Thick	18 to 36 inches
Medium	10 to 18 inches
Thin	2 to 10 inches
Very Thin	0.4 to 2 inches
Laminated	0.1 to 0.4 inches
Thinly Laminated	Less than 0.1 inches

Fracturing – Describes the degree and condition of fracturing (fault, joint, or shear):

Degree of Fracturing

Description	Spacing
Unfractured	Greater than 10 feet
Intact	3 to 10 feet
Slightly Fractured	1 to 3 feet
Moderately Fractured	

Condition of Fractures

Aperature Width

Description	Width
Open	Greater than 0.2 inches
Narrow	0.05 to 0.2 inches
Tight	Less than 0.05 inches

Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on surface
Slightly Rough	Asperities on the surfaces distinguishable
Slickensided	Surface has smooth, glassy finish, evidence of Striations

RQD – Rock Quality Designation:

RQD %	Rock Index Property Classification
0 – 25%	Very Poor
26 – 50%	Poor
51 – 70%	Fair
71 – 85%	Good
86 – 100%	Very Good

CLASSIFICATION OF SOILS

Ohio Department of Transportation

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

SYMBOL	DESCRIPTION	Classifcation		$LL_0/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
		AASHTO	OHIO							
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F S	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≦LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

- Sod and Topsoil
- Pavement or Base
- Uncontrolled Fill (Describe)
- Bouldery Zone
- Peat, S-Sedimentary W-Woody F-Fibrous L-Loamy & etc

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

APPENDIX III

BORING LOGS

BORING LOGS

Definitions of Abbreviations

AS = Auger sample

GI = Group index as determined from the Ohio Department of Transportation classification system

HP = Unconfined compressive strength as determined by a hand penetrometer (tons per square foot)

LL_o = Oven-dried liquid limit as determined by ASTM D4318. Per ASTM D2487, if LL_o/LL is less than 75 percent, soil is classified as "organic".

LOI = Percent organic content (by weight) as determined by ASTM D2974 (loss on ignition test)

PID = Photo-ionization detector reading (parts per million)

QR = Unconfined compressive strength of intact rock core sample as determined by ASTM D2938 (pounds per square inch)

QU = Unconfined compressive strength of soil sample as determined by ASTM D2166 (pounds per square foot)

RC = Rock core sample

REC = Ratio of total length of recovered soil or rock to the total sample length, expressed as a percentage

RQD = Rock quality designation – estimate of the degree of jointing or fracture in a rock mass, expressed as a percentage:

$$\frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \times 100$$

S = Sulfate content (parts per million)

SPT = Standard penetration test blow counts, per ASTM D1586. Driving resistance recorded in terms of blows per 6-inch interval while letting a 140-pound hammer free fall 30 inches to drive a 2-inch outer diameter (O.D.) split spoon sampler a total of 18 inches. The second and third intervals are added to obtain the number of blows per foot (N_m).

N_{60} = Measured blow counts corrected to an equivalent (60 percent) energy ratio (ER) by the following equation: $N_{60} = N_m*(ER/60)$

SS = Split spoon sample

2S = For instances of no recovery from standard SS interval, a 2.5 inch O.D. split spoon is driven the full length of the standard SS interval plus an additional 6.0 inches to obtain a representative sample. Only the final 6.0 inches of sample is retained. Blow counts from 2S sampling are not correlated with N_{60} values.

3S = Same as 2S, but using a 3.0 inch O.D. split spoon sampler.

TR = Top of rock

W = Initial water level measured during drilling

▼ = Water level measured at completion of drilling

Classification Test Data

Gradation (as defined on Description of Soil Terms):

GR = % Gravel
SA = % Sand
SI = % Silt
CL = % Clay

Atterberg Limits:

LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index

WC = Water content (%)

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / S.M.	DRILL RIG: CME-750 (SN 98048)	STATION / OFFSET: 176+13.92 / 34' RT	**EXPLORATION ID B-020-2-13**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / C.H.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-70 EB	
PID: 77372 BR ID: FRA-70-1373R	DRILLING METHOD: 3.25" HSA / RC	CALIBRATION DATE: 4/26/13	ELEVATION: 711.4 (MSL) EOB: 84.5 ft.	PAGE 1 OF 3
START: 7/16/13 END: 7/17/13	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 82.6	LAT / LONG: 39.953155708, -83.004534664	

MATERIAL DESCRIPTION AND NOTES	ELEV. 711.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.3' - ASPHALT (4.0")	711.1																	
0.5' - AGGREGATE BASE (6.0")	710.6																	
FILL: STIFF, BLACK AND BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. -ROCK FRAGMENTS PRESENT	708.4	1	4 8 6	19	72	SS-1	1.75	-	-	-	-	-	-	-	-	16	A-6a (V)	
FILL: VERY LOOSE, BLACK AND BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.	705.9	4	2 2 1	4	33	SS-2	-	47	16	12	19	6	26	23	3	15	A-1-b (0)	
POSSIBLE FILL: STIFF, BROWN **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP.	703.4	7	3 4 7	15	33	SS-3	2.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
POSSIBLE FILL: MEDIUM STIFF TO STIFF, BROWN **SILTY CLAY**, TRACE COARSE TO FINE SAND, MOIST.	698.4	10	2 2 3	7	83	SS-4	1.00	0	1	8	54	37	39	20	19	25	A-6b (12)	
		12	3 4 6	14	83	SS-5	1.75	-	-	-	-	-	-	-	-	27	A-6b (V)	
POSSIBLE FILL: MEDIUM STIFF, BROWN **CLAY**, SOME SILT, AND FINE TO COARSE SAND, LITTLE FINE GRAVEL, MOIST. -CONSOLIDATION TEST PERFORMED @ 14.7'	693.4	15			83	ST-6	0.75	17	31	13	24	15	41	16	25	22	A-7-6 (4)	
		17	1 1 2	4	33	SS-7	0.75	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
POSSIBLE FILL: LOOSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, WET. -HEAVING SANDS ENCOUNTERED @ 18.5' -COBBLES PRESENT @ 19.5'	690.9	W 19	WOH 2 4	8	33	SS-8	-	33	21	13	26	7	31	25	6	30	A-2-4 (0)	
DENSE TO VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.		22	4 13 10	32	67	SS-9	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		24	50/5"	-	80	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		27	9 12 14	36	33	SS-11	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		29	9 24 32	77	39	SS-12	-	47	27	10	12	4	21	18	3	7	A-1-b (0)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 3/31/15 08:54 - U:\GI\PROJECTS\2013\W-13-045.GPJ

PID: 77372	BR ID: FRA-70-1373R	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 176+13.92 / 34 RT	START: 7/16/13	END: 7/17/13	PG 2 OF 3	B-020-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
DENSE TO VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST. *(same as above)*	681.4	31																
		32																
		33																
		34	14 29 33	85	61	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		35																
		36																
		37																
		38																
		39	22 48 50/5"	-	71	SS-14	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		40																
		41																
		42																
		43																
		44	15 31 29	83	94	SS-15	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
HARD, BROWN **SILT AND CLAY**, LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, DAMP.	666.9	45					4.5+	11	1	4	46	38	32	18	14	17	A-6a (10)	
	664.4	46																
HARD, BROWN **SILTY CLAY**, LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, DAMP.		47																
		48																
		49	29 27 25	72	22	SS-16	-	-	-	-	-	-	-	-	-	18	A-6b (V)	
		50																
		51																
		52																
		53																
		54	11 20 20	55	56	SS-17	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
		55																
		56																
		57																
		58																
		59	14 50/3"	-	89	SS-18	-	19	3	4	36	38	38	20	18	16	A-6b (11)	
		60																
		61																
	649.4																	

PID: 77372	BR ID: FRA-70-1373R	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 176+13.92 / 34 RT	START: 7/16/13	END: 7/17/13	PG 3 OF 3	B-020-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
HARD, BROWN **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. *(same as above)*	649.3	63																
	647.1	TR 64	35 50/3"	-	100	SS-19	-	-	-	-	-	-	-	-	-	11	A-6a (V)	
SHALE: GRAY, VERY WEAK, HIGHLY WEATHERED.		65																
		66																
		67																
		68																
	641.9	69	49 50/2"	-	100	SS-20	-	-	-	-	-	-	-	-	-	9	Rock (V)	
SHALE : GRAY AND BLACK, SLIGHTLY TO MODERATELY WEATHERED, WEAK AND STRONG, THINLY LAMINATED TO MEDIUM BEDDED, CALCAREOUS, PYRITIC, FISSILE, FRACTURED TO HIGHLY FRACTURED, NARROW TO OPEN APERTURE, SMOOTH TO SLIGHTLY ROUGH; RQD 4%, REC 30%.		70																
		71																
		72	8		40	RC-1											CORE	
		73																
		74																
		75																
		76																
		77	0		20	RC-2											CORE	
		78																
	631.9	79																
LIMESTONE : GRAY AND TAN, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO MEDIUM BEDDED, CALCAREOUS, PYRITIC, DOLOMITIC, CHERT NODULES, FRACTURED TO SLIGHTLY FRACTURED, NARROW APERTURE, SMOOTH; RQD 97%, REC 97%.		80																
		81																
		82	97		97	RC-3											CORE	
		83																
	626.9	EOB 84																

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 18.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 94 LBS PORTLAND CEMENT / 100 LBS BENTONITE POWDER / 50 GAL WATER

B-020-2-13 – RC-1, RC-2, and RC-3 – Depth from 69.5 to 84.5 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.B./T.F.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 7007+77.61 / 12.0' RT	**EXPLORATION ID B-020-4-13**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B./S.M.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP D7	
PID: 89464 BR ID: FRA-70-1373B	DRILLING METHOD: 3.25" HSA / HQ	CALIBRATION DATE: 4/26/13	ELEVATION: 714.0 (MSL) EOB: 94.7 ft.	PAGE 1 OF 4
START: 3/5/14 END: 3/11/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 77.7	LAT / LONG: 39.954037, -83.004709	

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.2' - TOPSOIL (2.0")	713.8																	
FILL: STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST.		1 2 3	3 2 1	4	44	SS-1	1.25	-	-	-	-	-	-	-	-	25	A-6a (V)	
-TRACE ORGANICS AND WOOD FIBERS PRESENT IN SS-2		4 5 6	1 1 2	4	72	SS-2	1.25	14	14	16	31	25	32	18	14	28	A-6a (6)	
		7	3 3 3	8	72	SS-3	2.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
	706.0	8 9 10																
VERY STIFF TO HARD, BROWN **CLAY**, AND SILT, TRACE FINE SAND, TRACE FINE GRAVEL, MOIST.		11 12 13	3 5 6	14	72	SS-4	3.50	1	0	5	53	41	48	20	28	29	A-7-6 (17)	
		14	4 5 6	14	100	SS-5	3.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
	701.0	15																
LOOSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST TO WET.		16 17 18	WOH 2 2	5	56	SS-6	-	-	-	-	-	-	-	-	-	20	A-2-4 (V)	
	696.0	W 19 20 21	2 2 5	9	44	SS-7	-	33	17	16	25	9	NP	NP	NP	17	A-2-4 (0)	
MEDIUM DENSE TO DENSE, BROWN TO GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST TO WET.		W 22 23 24	4 6 11	22	33	SS-8	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
-INTRODUCED MUD @ 21.0'		25 26 27	6 12 15	35	100	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		28 29 30	8 12 18	39	78	SS-10	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
-COBBLES PRESENT THROUGHOUT		31 32 33	21 18 12	39	33	SS-11	-	61	15	8	10	6	NP	NP	NP	8	A-1-b (0)	
		34 35 36	4 4 5	12	33	SS-12	-	-	-	-	-	-	-	-	-	22	A-1-b (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:58 - U:\GI\8\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7007+77.61 / 12.0 RT	START: 3/5/14	END: 3/11/14	PG 2 OF 4	B-020-4-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE TO DENSE, BROWN TO GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST TO WET. *(same as above)*	684.0	31																
	682.0	32																
MEDIUM DENSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		33																
		34	1 1 17	23	44	SS-13	-	62	22	5	7	4	NP	NP	NP	11	A-1-a (0)	
		35																
		36																
	677.0	37																
VERY DENSE, GRAY **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		38																
		39	8 20 25	58	67	SS-14	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		40																
		41																
		42																
		43																
		44	18 26 27	69	83	SS-15	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		45																
		46																
		47																
		48																
		49	8 31 50	105	72	SS-16	-	83	10	3	3	1	NP	NP	NP	9	A-1-a (0)	
		50																
		51																
		52																
		53																
		54	50 50/3"	-	100	SS-17	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
-AUGER REFUSAL ON BOULDER @ 55.5'; SWITCHED TO MUD ROTARY DRILLING WITH CASING ADVANCER.		55																
		56																
	657.0	57																
HARD, GRAY **SILTY CLAY**, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP.		58																
		59	10 27 35	80	42	SS-18	4.5+	7	4	4	41	44	40	19	21	14	A-6b (12)	
		60																
		61																

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7007+77.61 / 12.0 RT	START: 3/5/14	END: 3/11/14	PG 3 OF 4	B-020-4-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
HARD, GRAY **SILTY CLAY**, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. *(same as above)*	651.9	63																
	649.6	64 TR	31 50/5"	-	91	SS-19	4.5+	-	-	-	-	-	-	-	-	16	A-6b (V)	
SHALE : GRAY, HIGHLY WEATHERED, VERY WEAK.		65																
		66																
		67																
		68																
		69	50/5"	-	100	SS-20	-	-	-	-	-	-	-	-	-	19	Rock (V)	
		70																
		71																
		72																
		73																
	639.3	74	50/5"	-	20	SS-21	-	-	-	-	-	-	-	-	-	23	Rock (V)	
SHALE : DARK GRAY, SLIGHTLY WEATHERED, WEAK, VERY THIN TO THIN BEDDED, ARGILLACEOUS, MODERATELY FRACTURED, NARROW APERTURES, SLICKENSIDED TO SLIGHTLY ROUGH; RQD 66%, REC 89%.		75	75		92	RC-1												CORE
	635.6	76																
CLAYSTONE : DARK GRAY, SLIGHTLY WEATHERED, VERY WEAK, THIN BEDDED, CALCAREOUS, FRACTURED, TIGHT APERTURES, SLICKENSIDED TO SLIGHTLY ROUGH; RQD 100%, REC 100%. -SHALE SEAM PRESENT FROM 79.7' TO 80.7'		77																
		78																
		79																
		80	100		100	RC-2												CORE
-PYRITIC FROM 80.7' TO 83.7'		81																
		82																
	630.3	83																
LIMESTONE : DARK BROWNISH GRAY, UNWEATHERED, MODERATELY STRONG TO STRONG, THIN TO MEDIUM BEDDED, CHERTY, DOLOMITIC, MODERATELY TO SLIGHTLY FRACTURED, NARROW TO OPEN APERTURES, SLIGHTLY ROUGH; RQD 87%, REC 95%. -QU @ 86.5' = 13,130 PSI		84																
		85																
		86																
		87	90		95	RC-3												CORE
		88																
		89																
		90																
-QU @ 90.7' = 16,178 PSI		91																
		92	85		95	RC-4												CORE
		93																
		94																

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7007+77.61 / 12.0 RT	START: 3/5/14	END: 3/11/14	PG 4 OF 4	B-020-4-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
	619.7																	
	619.3	EOB																

NOTES: SEEPAGE ENCOUNTERED @ 16.0'; GROUNDWATER ENCOUNTERED INITIALLY @ 18.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-020-4-13 – RC-1 and RC-2 – Depth from 74.7 to 84.7 feet

B-020-4-13 – RC-3 and RC-4 – Depth from 84.7 to 94.7 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.K.	DRILL RIG: CME-55 (SN 386345)	STATION / OFFSET: 7008+36.29 / 24.1' RT	**EXPLORATION ID B-020-6-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / N.A.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP D7		
PID: 89464 BR ID: FRA-70-1373B	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 10/20/14	ELEVATION: 714.1 (MSL) EOB: 95.0 ft.		PAGE 1 OF 4
START: 1/5/15 END: 1/12/15	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 92	LAT / LONG: 39.954069, -83.004499		

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.2' - CONCRETE (2.0")	713.9																	
0.6' - AGGREGATE BASE (7.0")	713.5																	
FILL: STIFF, BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST.		1	3 4 4	12	50	SS-1	1.50	14	15	16	32	23	33	20	13	21	A-6a (5)	
		2																
		3																
		4	2 3 3	9	33	SS-2	1.25	-	-	-	-	-	-	-	-	24	A-6a (V)	
	708.6	5																
FILL: LOOSE TO MEDIUM DENSE, BROWN **GRAVEL**, TRACE COARSE SAND, TRACE SILT, DAMP TO MOIST. -CINDERS PRESENT IN SS-3 -SLAG PRESENT IN SS-3 AND SS-4		6	7 7 5	18	44	SS-3	-	98	1	0	1	0	NP	NP	NP	6	A-1-a (0)	
		7																
		8																
		9	2 2 3	8	39	SS-4	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	
	703.6	10																
STIFF, GRAY **CLAY**, AND SILT, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. -IRON STAINING PRESENT IN SS-5 THROUGH SS-7		11																
		12	4 4 5	14	100	SS-5	1.75	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		13																
		14	4 4 5	14	100	SS-6	2.00	1	1	9	46	43	43	19	24	24	A-7-6 (14)	
		15																
W		16																
		17	2 1 2	5	44	SS-7	2.00	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
	696.1	18																
VERY STIFF, BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP.		19	9 8 10	27	100	SS-8	-	-	-	-	-	-	-	-	-	15	A-6a (V)	
	693.6	20																
MEDIUM DENSE TO DENSE, GRAY AND BLACK **GRAVEL**, TRACE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		21																
		22	10 13 11	36	39	SS-9	-	91	3	3	2	1	NP	NP	NP	12	A-1-a (0)	
		23																
		24	5 5 5	15	50	SS-10	-	-	-	-	-	-	-	-	-	13	A-1-a (V)	
	688.6	25																
W		26																
VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET. -ROCK FRAGMENTS PRESENT IN SS-11 -INTRODUCED MUD @26.0'		27	13 16 18	51	67	SS-11	-	59	18	6	11	6	29	23	6	25	A-1-b (0)	
	686.1	28																
VERY DENSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		29	35 34 30	96	100	SS-12	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7008+36.29 / 24.1 RT	START: 1/5/15	END: 1/12/15	PG 2 OF 4	B-020-6-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 684.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. *(same as above)*		31 32 33																
-ROCK FRAGMENTS PRESENT IN SS-13		34 35	44 23 27	75	100	SS-13	-	66	15	6	9	4	NP	NP	NP	11	A-1-a (0)	
		36 37 38																
		39	50/1"	-	0	SS-14	-	-	-	-	-	-	-	-	-	-		
		40 41 42 43																
-COBBLES AND BOULDERS PRESENT THROUGHOUT		44 45	38 23 40	95	100	SS-15	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		46 47 48																
		49 50	40 38 38	114	100	SS-16	-	70	16	6	5	3	20	15	5	10	A-1-a (0)	
		51 52 53																
		54	50/6"	-	100	SS-17	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
		55 56 57 58																
		59	50/1"	-	100	SS-18	-	-	-	-	-	-	-	-	-	3	A-1-a (V)	
	654.1																	
PINK AND BLACK GRANITE BOULDER	653.7	TR 60																
MUDSTONE : GRAY, UNWEATHERED, VERY WEAK, THICK BEDDED, CALCAREOUS, FRIABLE, FISSILE,	652.1	61																

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7008+36.29 / 24.1 RT	START: 1/5/15	END: 1/12/15	PG 3 OF 4	B-020-6-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
INTACT, TIGHT APERTURES, SLICKENSIDED; RQD 46%, REC 100%.	652.0	63	60		90	RC-1											CORE	
SHALE : GRAY, SLIGHTLY WEATHERED TO UNWEATHERED, VERY WEAK TO STRONG, LAMINATED TO THICK BEDDED, ARENACEOUS, CALCAREOUS, PYRITIC, CRYSTALLINE, FISSILE, SLIGHTLY TO HIGHLY FRACTURED, TIGHT TO OPEN APERTURES, SLIGHTLY TO VERY ROUGH; RQD 49%, REC 81%. *(same as above)*		64																
-0.5' MUDSTONE SEAM @ 65.0'		65																
-1.1' LIMESTONE SEAM @ 66.0'		66																
		67	0		33	RC-2											CORE	
		68																
		69																
		70																
-0.4' MUDSTONE SEAM @ 71.0'		71																
-0.4' LIMESTONE SEAM @ 71.4'		72																
-0.8' MUDSTONE SEAM @ 71.8'		73	64		100	RC-3											CORE	
		74																
-0.5' MUDSTONE SEAM @ 74.5'		75																
		76																
		77																
-QU @ 77.4' = 177 PSI		78	63		97	RC-4											CORE	
-0.3' CLAY SEAM @ 78.6'		79																
		80																
-0.2' CLAY SEAM @ 80.9'		81																
		82																
		83	57		83	RC-5											CORE	
		84																
	628.6	85																
LIMESTONE : GRAY AND BROWN, UNWEATHERED, MODERATELY STRONG TO STRONG, MEDIUM TO THICK BEDDED, CHERTY, CRYSTALLINE, PYRITIC, DOLOMITIC, SLIGHTLY FRACTURED, NARROW TO OPEN APERTURES, SLIGHTLY TO VERY ROUGH; RQD 94%, REC 100%.		86																
		87																
		88	89		100	RC-6											CORE	
		89																
		90																
		91																
-QU @ 91.5' = 12,531 PSI		92																
		93	100		100	RC-7											CORE	
		94																

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7008+36.29 / 24.1 RT	START: 1/5/15	END: 1/12/15	PG 4 OF 4	B-020-6-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI			
	619.8																	
	619.1	EOB 95																

NOTES: SEEPAGE ENCOUNTERED @ 16.0'; GROUNDWATER ENCOUNTERED INITIALLY @ 26.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 150 LBS BENTONITE CHIPS AND SOIL CUTTINGS; PUMPED 47 LBS CEMENT / 100 LBS BENTONITE POWDER / 40 GAL WATER

B-020-6-13 – RC-1 – Depth from 60.0 to 65.0 feet

B-020-6-13 – RC-2 and RC-3 – Depth from 65.0 to 75.0 feet

B-020-6-13 – RC-4 – Depth from 75.0 to 80.0 feet

B-020-6-13 – RC-5 and RC-6 – Depth from 80.0 to 90.0 feet

B-020-6-13 – RC-7 – Depth from 90.0 to 95.0 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: STOCK / J/M	DRILL RIG: CME 55-LC (SN 360485)	STATION / OFFSET: 176+68.64 / 1.8' RT	**EXPLORATION ID B-020-7-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / K.R.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-70 WB		
PID: 89464 BR ID: FRA-70-1373L	DRILLING METHOD: 4.25" HSA / NQ	CALIBRATION DATE: 3/28/13	ELEVATION: 713.5 (MSL) EOB: 80.4 ft.		PAGE 1 OF 3
START: 1/19/15 END: 1/22/15	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 73.2	LAT / LONG: 39.953452, -83.004377		

MATERIAL DESCRIPTION AND NOTES	ELEV. 713.5	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
0.7' - CONCRETE (8.0")	712.8																	
POSSIBBLE FILL: LOOSE TO MEDIUM DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST.		1	5 4 4	10	83	SS-1	-	-	-	-	-	-	-	-	-	12	A-2-4 (V)	
		2																
		3																
		4	WOH 2 3	6	67	SS-2	-	25	31	17	19	8	NP	NP	NP	13	A-2-4 (0)	
	706.5	5																
POSSIBBLE FILL: STIFF, DARK BROWN **CLAY**, "AND" SILT, TRACE COARSE TO FINE SAND, MOIST.		6																
		7																
		8																
		9	2 4 6	12	11	SS-3	-	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
-SWITCHED TO ROTARY DRILLING TECHNIQUES WITH WATER AND CASING ADVANCER @ 10.0'		10																
		11																
-CONSOLIDATION TEST PERFORMED @ 11.8' -CU TRIAXIAL COMPRESSION TEST PERFORMED @ 12.0'		12			71	ST-4	1.50	0	2	7	45	46	43	19	24	23	A-7-6 (14)	
	700.5	13																
POSSIBBLE FILL: MEDIUM STIFF TO STIFF, BROWN **SILTY CLAY**, TRACE FINE SAND, TRACE FINE GRAVEL, MOIST.		14	2 3 4	9	81	S-5	1.25	1	0	8	49	42	38	19	19	26	A-6b (12)	
		15																
		16																
	696.4	17			63	ST-6	0.75	-	-	-	-	-	-	-	-	-	A-6b (V)	
POSSIBBLE FILL: HARD, REDDISH BROWN **SANDY SILT**, LITTLE FINE GRAVEL, LITTLE CLAY, MOIST.	695.5						4.50	19	14	12	40	15	26	21	5	21	A-4a (4)	
POSSIBBLE FILL: MEDIUM STIFF, BROWN **CLAY**, "AND" SILT, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		18																
		19	1 2 3	6	33	SS-7	-	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
	693.0	20																
VERY DENSE, BLACK **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		21																
		22			0	ST-8	-	-	-	-	-	-	-	-	-	-		
		23																
-COBBLES PRESENT @ 24.0'		24	7 19 20	48	61	SS-9	-	78	11	5	4	2	NP	NP	NP	11	A-1-a (0)	
	686.5	25																
DENSE, BROWN AND BLACK **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST.		26																
		27																
-HEAVING SANDS ENCOUNTERED @ 28.5'		28																
		29	5 13 14	33	100	SS-10	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:58 - U:\GI\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: FRA-70-1373L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 176+68.64 / 1.8 RT	START: 1/19/15	END: 1/22/15	PG 2 OF 3	B-020-7-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
DENSE, BROWN AND BLACK **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST. *(same as above)*	683.5	31																
	681.5	32																
HARD, BROWNISH GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST.		33																
	679.5	34	11 20 33	65	72	SS-11	4.5+	11	11	19	33	26	27	15	12	13	A-6a (6)	
VERY DENSE, BLACK **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.		35					-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		36																
		37																
		38																
		39	6 20 38	71	94	SS-12	-	54	14	22	7	3	NP	NP	NP	14	A-1-b (0)	
-COBBLES PRESENT @ 40.0'		40																
	671.5	41																
HARD, GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.		42																
		43																
		44	4 6 21	33	44	SS-13	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
		45																
	666.5	46																
VERY DENSE, GRAY AND BLACK **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		47																
		48																
		49	9 32 41	89	100	SS-14	-	70	13	9	5	3	NP	NP	NP	10	A-1-a (0)	
		50																
		51																
		52																
		53																
	659.5	54	5				-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
HARD, GRAY **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		55	20 39	72	78	SS-15	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	
AUGER REFUSAL @ 55.0'		56			25	RC-1	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
-0.8' GRANITE BOULDER @ 56.5'		57																
		58																
		59			33	RC-2	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		60																
-0.8' MUDSTONE SEAM @ 60.7'		61																

PID: 89464	BR ID: FRA-70-1373L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 176+68.64 / 1.8 RT	START: 1/19/15	END: 1/22/15	PG 3 OF 3	B-020-7-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
HARD, GRAY **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. *(same as above)* -0.1' THICK PIECE OF GRANITE RECOVERED IN RC-3. REMAINING SOIL WASHED OUT DURING CORING.	651.4	63 64 65			2	RC-3	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
	648.1	TR																
MUDSTONE : GRAY, HIGHLY WEATHERED, VERY WEAK, THINLY LAMINATED TO THIN BEDDED, ARENACEOUS, CALCAREOUS, FRIABLE, FISSILE, SLIGHTLY TO HIGHLY FRACTURED, THIGHT APERTURES, SLIGHTLY ROUGH; RQD 74%, REC 98%.		66 67 68 69 70 71 72 73 74 75	89		97	RC-4											CORE	
-POINT LOAD STRENGTH @ 69.4' to 74.8' -MEAN QU = 110 PSI		76 77 78 79 80	45		100	RC-5											CORE	
	633.1	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED PRIOR TO INTORDUCTION OF WATER AS A DRILLING FLUID

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 150 LBS BENTONITE CHIPS AND SOIL CUTTINGS

B-020-7-13 – RC-1, RC-2, RC-3 and RC-4 – Depth from 55.0 to 73.5 feet

B-020-7-13 – RC-4 (cont.) and RC-5 – Depth from 73.5 to 80.4 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.K.	DRILL RIG: CME-55 (SN 386345)	STATION / OFFSET: 7010+15.89 / 30.7' RT	**EXPLORATION ID**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / N.A.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP D7	**B-020-8-13**	
PID: 89464 BR ID: FRA-70-1373B	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 10/20/14	ELEVATION: 721.0 (MSL) EOB: 102.0 ft.	PAGE	
START: 12/15/14 END: 12/19/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 92	LAT / LONG: 39.954179, -83.003900	1 OF 4	

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
0.7' - CONCRETE (8.0")	720.3																	
0.3' - AGGREGATE BASE (4.0")	720.0																	
FILL: LOOSE, BROWN **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP TO MOIST.		1	2 3 2	8	56	SS-1	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	
-ROCK FRAGMENTS PRESENT THROUGHOUT	715.5	2 3 4 5	2 2 3	8	56	SS-2	-	40	19	12	13	16	28	18	10	15	A-2-4 (0)	
MEDIUM DENSE, GRAY **GRAVEL**, DRY. -LIMESTONE FRAGMENTS PRESENT IN SS-3	713.0	6 7 8	5 7 8	23	33	SS-3	-	-	-	-	-	-	-	-	-	1	A-1-a (V)	
DENSE TO VERY DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST.		9 10 11 12 13 14 15	50/6"	-	0	SS-4	-	-	-	-	-	-	-	-	-	-		
			26 16 13	44	67	SS-5	-	77	12	4	3	4	20	19	1	6	A-1-a (0)	
			13 24 23	71	33	SS-6	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
		W 16	50/6"	-	100	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
-INTRODUCED MUD @ 20.0'	700.5	W 17 18 19 20	15 16 16	48	0	SS-8	-	-	-	-	-	-	-	-	-	-		
DENSE TO VERY DENSE, BROWN **COARSE AND FINE SAND**, TRACE TO LITTLE CLAY, TRACE SILT, TRACE FINE GRAVEL, WET.		21 22 23 24 25 26 27 28 29	25 26 26	78	100	SS-9	-	1	10	70	9	10	NP	NP	NP	21	A-3a (0)	
			10 13 18	47	100	SS-10	-	-	-	-	-	-	-	-	-	21	A-3a (V)	
			8 11 15	39	100	SS-11	-	1	14	61	10	14	NP	NP	NP	22	A-3a (0)	
			11 16 16	48	100	SS-12	-	-	-	-	-	-	-	-	-	20	A-3a (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:58 - U:\GI\8\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7010+15.89 / 30.7 RT	START: 12/15/14	END: 12/19/14	PG 2 OF 4	B-020-8-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
DENSE TO VERY DENSE, BROWN **COARSE AND FINE SAND**, TRACE TO LITTLE CLAY, TRACE SILT, TRACE FINE GRAVEL, WET. *(same as above)*	691.0	31																
	689.0	32																
VERY DENSE, GRAY TO BROWN **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.		33																
		34	27 20 37	86	100	SS-13	-	36	38	13	6	7	NP	NP	NP	12	A-1-b (0)	
		35																
	684.0	36																
-GRANITE BOULDER ENCOUNTERED @ 37.0'		37																
		38																
-SWITCHED TO MUD ROTARY DRILLING WITH TRICONE BIT @ 39.0'		39	50/1"	-	0	SS-14	-	-	-	-	-	-	-	-	-	-		
		40																
-COBBLES AND BOULDERS PRESENT THROUGHOUT		41																
		42																
		43																
		44	43 50/5"	-	73	SS-15	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		45																
		46																
		47																
		48																
		49	47 50/1"	-	71	SS-16	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		50																
		51																
	669.0	52																
HARD, GRAY **CLAY**, SOME SILT, TRACE COARSE TO FINE SAND, DAMP TO MOIST.		53																
		54	8 30 40	105	100	SS-17	4.5+	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		55																
		56																
		57																
		58																
		59	40 50/6"	-	100	SS-18	4.5+	0	1	2	32	65	43	21	22	17	A-7-6 (13)	
		60																
		61																

2014 ODOT BORING LOG-RI NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:58 - U:\GI\8\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7010+15.89 / 30.7 RT	START: 12/15/14	END: 12/19/14	PG 3 OF 4	B-020-8-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
HARD, GRAY **CLAY**, SOME SILT, TRACE COARSE TO FINE SAND, DAMP TO MOIST. *(same as above)*	658.9	63																
		64	50/1"	-	0	SS-19	-	-	-	-	-	-	-	-	-	-		
	656.0	TR 65																
MUDSTONE : GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, MEDIUM BEDDED, CALCAREOUS, FISSILE, ARGILLACEOUS, MODERATELY FRACTURED, TIGHT TO OPEN APERTURES, VERY ROUGH; RQD 29%, REC 58%.	653.7	66	33		52	RC-1											CORE	
SHALE : GRAY, SLIGHTLY WEATHERED TO UNWEATHERED, VERY WEAK TO STRONG, LAMINATED TO VERY THICK BEDDED, ARENACEOUS, ARGILLACEOUS, FISSILE, SLIGHTLY FRACTURED TO FRACTURED, TIGHT TO OPEN APERTURES, VERY ROUGH; RQD 63%, REC 86%. -QU @ 71.2' = 275 PSI -0.4' LIMESTONE SEAM @ 72.0'		67 68 69 70 71 72	72		97	RC-2											CORE	
-CALCAREOUS FROM 77.0' TO 82.0'		73 74 75 76 77	83		100	RC-3											CORE	
		78 79 80 81 82	68		90	RC-4											CORE	
-QU @ 85.9' = 318 PSI		83 84 85 86 87	78		95	RC-5											CORE	
		88 89 90 91	8		52	RC-6											CORE	
	629.0	92																
LIMESTONE : GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, ARENACEOUS, FERRIFEROUS, SILICEOUS, PYRITIC, INTACT, NARROW APERTURES, SLIGHTLY ROUGH; RQD 100%, REC 100%.		93 94																

PID: 89464	BR ID: FRA-70-1373B	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7010+15.89 / 30.7 RT	START: 12/15/14	END: 12/19/14	PG 4 OF 4	B-020-8-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
LIMESTONE : GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, ARENACEOUS, FERRIFEROUS, SILICEOUS, PYRITIC, INTACT, NARROW APERTURES, SLIGHTLY ROUGH; RQD 100%, REC 100%. *(same as above)*	626.7	95	100		100	RC-7												CORE	
-QU @ 97.1' = 4,737 PSI		96																	
		97																	
		98																	
		99	100		100	RC-8												CORE	
		100																	
		101																	
	619.0	EOB 102																	

NOTES: SEEPAQGE ENCOUNTERED @ 16.0'; GROUNDWATER INITIALLY ENCOUNTERED @ 18.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS

B-020-8-13 – RC-1 and RC-2 – Depth from 65.0 to 72.0 feet

B-020-8-13 – RC-3 – Depth from 72.0 to 77.0 feet

B-020-8-13 – RC-4 and RC-5 – Depth from 77.0 to 87.0 feet

B-020-8-13 – RC-6 and RC-7 – Depth from 87.0 to 97.0 feet

B-020-8-13 – RC-8 – Depth from 97.0 to 102.0 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / J.K.	DRILL RIG: CME 55 (SN 386345)	STATION / OFFSET: 5081+05.25 / 39.8' RT	**EXPLORATION ID B-020-9-15**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / C.D.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL RAMP C5		
PID: 77372 BR ID: FRA-70-1373A	DRILLING METHOD: 4.25" HSA / RC	CALIBRATION DATE: 10/20/14	ELEVATION: 713.0 (MSL) EOB: 75.5 ft.		PAGE 1 OF 3
START: 3/16/15 END: 3/17/15	SAMPLING METHOD: SPT / HQ	ENERGY RATIO (%): 92	LAT / LONG: 39.952886963, -83.004333117		

MATERIAL DESCRIPTION AND NOTES	ELEV. 713.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.3'- ASPHALT (4.0")	712.7																	
0.4' - BRICK (4.0")	712.3																	
0.3' - AGGREGATE BASE (3.0")	712.0																	
POSSIBLE FILL: STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP TO MOIST.		1	5 4 3	11	56	SS-1	1.25	-	-	-	-	-	-	-	-	22	A-6a (V)	
		2																
		3																
		4	4 4 4	12	100	SS-2	1.50	10	10	14	37	29	35	20	15	18	A-6a (8)	
	707.5	5																
POSSIBLE FILL: STIFF, DARK BROWN AND BLACK TO BROWNISH GRAY **SILTY CLAY**, LITTLE COARSE TO FINE SAND, MOIST.		6	3 2 4	9	61	SS-3	2.00	-	-	-	-	-	-	-	-	37	A-6b (V)	
		7																
		8																
		9	4 4 6	15	100	SS-4	2.00	0	1	13	50	36	34	18	16	21	A-6b (10)	
	702.5	10																
DENSE, GRAY **GRAVEL AND SAND**, TRACE SILT, TRACE CLAY, DAMP. -ROCK FRAGMENTS PRESENT IN SS-5		11	7 11 12	35	39	SS-5	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
	700.0	12																
MEDIUM DENSE, BROWN **SANDY SILT**, "AND" FINE GRAVEL, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-6		13																
		14	6 5 13	28	100	SS-6	-	38	15	10	29	8	22	19	3	14	A-4a (0)	
	697.5	15																
VERY DENSE, BROWNISH GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-7		16																
		17	20 14 24	58	89	SS-7	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	695.0	18																
MEDIUM DENSE, BROWNISH GRAY **SANDY SILT**, SOME FINE GRAVEL, TRACE CLAY, MOIST.		19	13 9 9	28	100	SS-8	-	34	18	12	26	10	NP	NP	NP	10	A-4a (0)	
	692.5	20																
MEDIUM DENSE TO VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.		21																
		22	14 43 17	92	50	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		23																
-ROCK FRAGMENTS PRESENT THROUGHOUT	W	24	13 4 8	18	33	SS-10	-	33	38	9	13	7	NP	NP	NP	16	A-1-b (0)	
		25																
		26																
-PETROLEUM ODOR PRESENT IN SS-11		27	23 25 50/4"	-	88	SS-11	-	47	21	14	12	6	NP	NP	NP	11	A-1-b (0)	
	685.0	28																
VERY DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST. -INTRODUCED MUD @ 30.0'		29	7 14 19	51	100	SS-12	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 3/28/15 13:40 - U:\GI\PROJECTS\2013\W-13-045.GPJ

PID: 77372	BR ID: FRA-70-1373A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5081+05.25 / 39.8 RT	START: 3/16/15	END: 3/17/15	PG 2 OF 3	B-020-9-15

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST. *(same as above)*	683.0	31																
		32																
		33																
		34	5 30 42	110	100	SS-13	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	
		35																
		36																
	676.0	37																
VERY DENSE, GRAY **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST.		38																
		39	34 37 50/5"	-	82	SS-14	-	35	18	14	15	18	26	13	13	9	A-2-6 (1)	
		40																
		41																
	671.0	42																
VERY DENSE, BROWNISH GRAY TO GRAY **GRAVEL AND SAND**, TRACE SILT, TRACE CLAY, MOIST.		43																
		44	17 32 15	72	100	SS-15	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		45																
		46																
		47																
		48																
		49	17 50/5"	-	73	SS-16	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
-ROCK FRAGMENTS PRESENT IN SS-16		50																
		51																
	661.0	52																
VERY STIFF TO HARD, GRAY **CLAY**, SOME SILT, LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, DAMP.		53																
		54	12 24 39	97	100	SS-17	4.5+	11	3	3	34	49	42	19	23	14	A-7-6 (14)	
		55																
-BECOMING SHALE WITH DEPTH		56																
		57																
		58																
		59	23 50/4"	-	100	SS-18	3.75	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
	652.5	60																
	TR	61																

PID: 77372	BR ID: FRA-70-1373A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5081+05.25 / 39.8 RT	START: 3/16/15	END: 3/17/15	PG 3 OF 3	B-020-9-15

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
SHALE : DARK GRAY TO BLACK, HIGHLY WEATHERED, VERY WEAK TO WEAK, THINLY LAMINATED TO MEDIUM BEDDED, ARENACEOUS, CALCAREOUS, FRIABLE, FISSILE, JOINTED, MODERATELY TO HIGHLY FRACTURED, THIGHT TO OPEN APERTURES, SLIGHTLY TO VERY ROUGH; RQD 48%, REC 75%. *(same as above)* -0.4' GRANITE BOULDER @ 60.5' -0.2' CLAY SEAM @ 60.9' -0.4' LIMESTONE SEAM @ 61.5' -0.5' LIMESTONE SEAM @ 64.5'	650.9	63 64 65	17		52	RC-1											CORE	
		66 67 68 69 70	48		75	RC-2											CORE	
-SLIGHTLY WEATHERED AND SLIGHTLY FRACTURED IN RC-3		71 72 73 74 75	80		100	RC-3											CORE	
	637.5	EOB																

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 24.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-020-9-13 ALT – RC-1 and RC-2 – Depth from 60.5 to 70.5 feet

B-020-9-13 ALT – RC-3 – Depth from 70.5 to 75.5 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.B.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 7011+57.17 / 20.9' RT	**EXPLORATION ID B-021-3-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP D7		
PID: 89464 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 727.0 (MSL) EOB: 34.4 ft.		PAGE 1 OF 2
START: 3/20/14 END: 3/20/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77.7	LAT / LONG: 39.954262, -83.003407		

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
0.2' - ASPHALT (3.0")	727.0																	
0.7' - CONCRETE (8.0")	726.8																	
FILL: STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DRY. -BRICK AND ROCK FRAGMENTS PRESENT IN SS-1	726.1	1	12 6 5	14	67	SS-1	1.75	19	15	13	30	23	28	16	12	8	A-6a (4)	
	724.0	2																
MEDIUM DENSE TO DENSE, GRAY TO BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP. -PETROLEUM ODOR PRESENT IN SS-2		3																
		4	8 14 15	38	56	SS-2	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		5																
		6																
		7	17 17 15	41	44	SS-3	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
-ROCK FRAGMENTS PRESENT THROUGHOUT		8																
		9	11 12 14	34	100	SS-4	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		10																
		11																
		12	24 12 10	28	78	SS-5	-	18	46	17	11	8	NP	NP	NP	7	A-1-b (0)	
	714.0	13																
VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP.		14	17 50/5"	-	73	SS-6	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		15																
-ROCK FRAGMENTS PRESENT THROUGHOUT		16	50/5"	-	100	SS-7	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
	709.0	17																
MEDIUM DENSE, BROWN **COARSE AND FINE SAND**, SOME CLAY, LITTLE SILT, MOIST.		18																
W		19	6 6 5	14	0	SS-8	-	-	-	-	-	-	-	-	-	-		
-ROCK FRAGMENTS PRESENT 2S-8A	706.5	20	36	-	67	2S-8A	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT SS-9		21	48 50/0"	-	83	SS-9	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
W	704.0	22																
HARD, GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP. -ROCK FRAGMENTS PRESENT IN SS-10		23																
		24	24 40 41	105	56	SS-10	4.5+	23	14	15	27	21	25	14	11	9	A-6a (3)	
	700.5	25																
VERY DENSE, BROWN **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE FINE GRAVEL, WET.		26	29 26 30	73	83	SS-11	4.5+ -	- 1	- 24	- 54	- 14	- 7	- NP	- NP	- NP	11 20	A-6a (V) A-3a (0)	
	699.0	27																
HARD, BROWN TO GRAY **SANDY SILT**, SOME CLAY, LITTLE FINE GRAVEL, DAMP.		28																
		29	16 18 24	54	94	SS-12	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:58 - U:\GI\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: N/A	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 7011+57.17 / 20.9 RT	START: 3/20/14	END: 3/20/14	PG 2 OF 2	B-021-3-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
HARD, BROWN TO GRAY **SANDY SILT**, SOME CLAY, LITTLE FINE GRAVEL, DAMP. *(same as above)*	697.0	31																
-INTRODUCED WATER @ 30.0'		32	18 24 50	96	94	SS-13	4.5+	12	12	19	30	27	24	14	10	10	A-4a (4)	
		33																
-GRANITE FRAGMENTS PRESENT IN SS-14	692.6	34 EOB	19 50/5"	-	45	SS-14	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	

NOTES: SEEPAGE ENCOUNTERED @ 18.5'; GROUNDWATER ENCOUNTERED INITIALLY @ 21.0'; CAVE-IN DEPTH @ 25.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.B.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 7012+73.67 / 45.0' RT	**EXPLORATION ID B-023-2-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP D7		
PID: 89464 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 733.1 (MSL) EOB: 25.0 ft.		PAGE 1 OF 1
START: 3/20/14 END: 3/20/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77.7	LAT / LONG: 39.954244, -83.002984		

MATERIAL DESCRIPTION AND NOTES	ELEV. 733.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.9' - TOPSOIL (11.0")	732.2																	
FILL: MEDIUM DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP. -COULD NOT ADVANCE AUGERS OR ATTEMPT SPLIT SPOON SAMPLE @ 1.0' DUE TO SIGNIFICANT PRESENCE OF CONSTRUCTION DEBRIS. OBTAINED REPRESENTATIVE SAMPLE FROM AUGER CUTTINGS. -PETROLEUM ODOR PRESENT IN SS-1	727.6		8 9 10	25	33	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
VERY STIFF, BROWN **SANDY SILT**, SOME CLAY, TRACE FINE GRAVEL, MOIST. -IRON STAINING PRESENT IN SS-2	725.1		5 5 8	17	56	SS-2	2.50	4	11	11	44	30	25	16	9	17	A-4a (8)	
MEDIUM DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-3	723.1		4 8 11	25	6	SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
STIFF, BROWN **SILT AND CLAY**, LITTLE TO SOME COARSE TO FINE SAND, MOIST.	722.1		13	-	100	2S-3A	2.00	-	-	-	-	-	-	-	-	20	A-6a (V)	
MEDIUM DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST.	717.6	W	6 5 5	13	0	SS-4	-	-	-	-	-	-	-	-	-	-		
			6	-	100	2S-4A	-	42	23	9	18	8	21	16	5	10	A-2-4 (0)	
			5 5 4	12	0	SS-5	-	-	-	-	-	-	-	-	-	-		
			8	-	0	2S-5A	-	-	-	-	-	-	-	-	-	-		
MEDIUM STIFF TO STIFF, GRAY **SILT AND CLAY**, TRACE FINE GRAVEL, MOIST. -INTORODUCED WATER @ 18.5'	712.6		2 2 3	6	61	SS-6	0.75	1	0	0	44	55	33	17	16	27	A-6b (10)	
			4 7 11	23	89	SS-7	2.00	-	-	-	-	-	-	-	-	28	A-6b (V)	
MEDIUM DENSE TO VERY DENSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.	708.1	EOB	3 9 14	30	100	SS-8	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	
			19 22 24	60	100	SS-9	-	55	21	10	9	5	NP	NP	NP	8	A-1-a (0)	

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 13.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE CHIPS / 40 GAL WATER

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 12:59 - U:\GI\PROJECTS\2013\W-13-072.GPJ

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / S.B.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 5086+86.08 / 34.9' LT	**EXPLORATION ID B-024-2-14**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / N.A.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP C5		
PID: 77372 BR ID: FRA-70-1390	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 742.7 (MSL) EOB: 59.2 ft.		PAGE 1 OF 2
START: 2/11/15 END: 2/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77.7	LAT / LONG: 39.953082824, -83.002320685		

MATERIAL DESCRIPTION AND NOTES	ELEV. 742.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.4' - ASPHALT (5.0")	742.3																	
1.1' - CONCRETE (13.0")	741.2																	
VERY STIFF TO HARD, BROWN TO GRAY **SANDY SILT**, SOME CLAY, LITTLE FINE GRAVEL, DAMP.		1																
		2	8 12 13	32	78	SS-1	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
		3																
		4	5 6 7	17	100	SS-2	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		5																
		6																
		7	3 7 9	21	100	SS-3	2.75	16	17	17	30	20	22	13	9	11	A-4a (3)	
		8																
		9	3 5 8	17	100	SS-4	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		10																
		11																
		12	5 5 5	13	100	SS-5	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		13																
		14	5 9 12	27	100	SS-6	4.5+	14	15	18	30	23	21	13	8	9	A-4a (4)	
		15																
		16																
		17	8 12 14	34	100	SS-7	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
	724.7	18																
MEDIUM DENSE, GRAY **SANDY SILT**, TRACE CLAY, MOIST.		19	9 10 10	26	100	SS-8	-	0	0	47	48	5	NP	NP	NP	20	A-4a (4)	
	722.2	20																
VERY STIFF, DARK GRAY **SANDY SILT**, SOME CLAY, MOIST.		21																
		22	5 10 11	27	100	SS-9	4.00	-	-	-	-	-	-	-	-	17	A-4a (V)	
		23																
		24	5 9 9	23	100	SS-10	3.00	0	0	18	48	34	22	14	8	19	A-4a (8)	
	717.2	25																
MEDIUM DENSE, GRAY **SILT**, LITTLE FINE SAND, LITTLE CLAY, TRACE FINE GRAVEL, WET.		W 26																
		27	2 5 6	14	100	SS-11	-	-	-	-	-	-	-	-	-	30	A-4b (V)	
		28																
		29	9 10 11	27	100	SS-12	-	1	0	17	67	15	NP	NP	NP	22	A-4b (8)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 3/26/15 19:13 - U:\GI\PROJECTS\2013\W-13-045.GPJ

PID: 77372	BR ID: FRA-70-1390	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5086+86.08 / 34.9 LT	START: 2/11/15	END: 2/13/15	PG 2 OF 2	B-024-2-14

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, GRAY **SILT**, LITTLE FINE SAND, LITTLE CLAY, TRACE FINE GRAVEL, WET. *(same as above)*	712.7																	
	710.7																	
MEDIUM DENSE TO VERY DENSE, GRAY **GRAVEL AND SAND**, TRACE SILT, TRACE CLAY, MOIST TO WET.		31																
		32																
		33																
		34	3 4 9	17	100	SS-13	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
		35																
		36																
		37																
		38																
		39	12 18 21	51	100	SS-14	-	40	23	27	6	4	NP	NP	NP	11	A-1-b (0)	
	700.7	40																
HARD, GRAY **SANDY SILT**, TRACE CLAY, TRACE FINE GRAVEL, DAMP.		41																
		42																
		43																
		44	15 19 21	52	100	SS-15	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
	695.7	45																
VERY DENSE, GRAY **GRAVEL AND SAND**, TRACE SILT, TRACE CLAY, MOIST.		46																
		47																
		48																
		49	25 32 41	95	100	SS-16	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
-HEAVING SANDS ENCOUNTERED @ 48.5'		50																
		51																
		52																
		53																
		54	50/5"	-	0	SS-17	-	-	-	-	-	-	-	-	-	-		
		55																
		56																
		57																
		58																
-NO RECOVERY IN SS-17 AND SS-18. SOIL TYPE DETERMINED BASED ON VISUAL DESCRIPTION OF SOIL CUTTINGS ON FIELD LOG.	683.5	59 EOB	50 50/2"	-	0	SS-18	-	-	-	-	-	-	-	-	-	-		

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 26.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE CHIPS / 40 GAL WATER

2014 ODOT BORING LOG-RI NE BRIDGE ID - OH DOT.GDT - 3/26/15 19:13 - U:\GI\PROJECTS\2013\W-13-045.GPJ

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

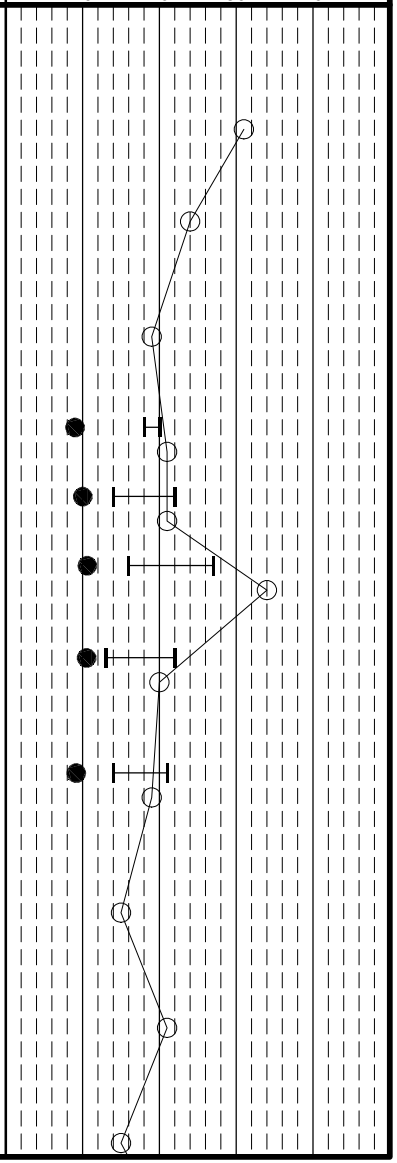
LOG OF: Boring B-025-0-08 | *Location:* Sta. 5088+53.62, 76.0' LT., BL RAMP C5 | *Date Drilled:* 7/24/2008

WATER OBSERVATIONS:
Water seepage at: 26.0'
Water level at completion: 39.0'

FIELD NOTES:
Advanced boring using 3.25" diameter hollowstem augers.

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	740.4													
1.2	739.2						Asphalt Concrete - 7" Aggregate Base - 7"							
		14 13 17	15	1		4.5+	FILL: Hard brown SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; contains few brick fragments; damp.							
3.5	736.9													
5		11 10 14	14	2		4.5+	Hard gray SANDY SILT (A-4a), some to "and" fine to coarse sand, trace to little gravel; damp.							
		6 8 11	14	3		4.5+								
10		7 10 11	18	4		4.5+			18	12	---	16	32	22
11.5	728.9	6 10 11	18	5		4.5+			8	15	---	20	36	21
		14 16 17	4	6		4.5+	Hard gray SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; damp to moist.		12	16	---	18	34	20
13.5	726.9													
15		5 8 12	18	7		4.5+	Very stiff to hard gray SANDY SILT (A-4a), some to "and" fine to coarse sand, trace to little gravel; damp.							
		5 7 12	18	8		4.5+			15	14	---	19	31	21
20		4 6 9	18	9		2.75								
		5 9 12	18	10		4.5								
25	715.4	5 6 9	18	11		2.5								

STANDARD PENETRATION (N60)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-025-0-08 | *Location:* Sta. 5088+53.62, 76.0' LT., BL RAMP C5 | *Date Drilled:* 7/24/2008

WATER OBSERVATIONS:
Water seepage at: 26.0'
Water level at completion: 39.0'

FIELD NOTES:
Advanced boring using 3.25" diameter hollowstem augers.

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N60) / Natural Moisture Content, % - / PL — LL / Blows per foot - ○ / Non-Plastic - NP
	715.4														
		3 6 17	13	12		3.5	Very stiff gray SILTY CLAY (A-6b), little fine sand; moist.								
28.5	711.9														
		17 29 37	10	13			Very dense brown GRAVEL WITH SAND (A-1-b), some fine to coarse sand, little silty clay; wet.								67
30							@ 30.0'-38.5', encountered cobbles while augering.								
		29 50/5	6	14					50	21	---	10	14	5	NP 50+
35															
38.5	701.9														
		23 50/6	10	15		4.5+	Hard gray SANDY SILT (A-4a), some fine to coarse sand, trace gravel; damp.								50+
40															
43.5	696.9														
		9 30 37	12	16			Very dense gray GRAVEL WITH SAND (A-1-b), "and" fine to coarse sand, little silt; wet.								68
45															
		22 39 30	15	17					39	26	---	22	--13--		NP 70
50	690.4														

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-025-0-08 | *Location:* Sta. 5088+53.62, 76.0' LT., BL RAMP C5 | *Date Drilled:* 7/24/2008

WATER OBSERVATIONS:
Water seepage at: 26.0'
Water level at completion: 39.0'

FIELD NOTES:
Advanced boring using 3.25" diameter hollowstem augers.

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N60) Natural Moisture Content, % - ● PL ⊢ LL Blows per foot - ○ / Non-Plastic - NP (10 20 30 40)
	690.4						Very stiff gray SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; moist.								
55		22 33 26	13	18		2.5									60 ○
57.0	683.4														
							Very dense brown COARSE AND FINE SAND (A-3a), some silt, little gravel; wet.								
59.3	681.1	48 50/3	9	19											50+ ○
							Bottom of Boring - 59.3'								
60															
65															
70															
75															

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / S.M.	DRILL RIG: CME-750 (SN 98048)	STATION / OFFSET: 5091+04.93 / 11.5' LT	**EXPLORATION ID B-026-3-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / K.S.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL RAMP C5		
PID: 77372 BR ID: FRA-70-1390	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 756.9 (MSL) EOB: 90.0 ft.		PAGE 1 OF 3
START: 8/21/13 END: 8/22/13	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.6	LAT / LONG: 39.953296762, -83.000848553		

MATERIAL DESCRIPTION AND NOTES	ELEV. 756.9	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
0.5' - CONCRETE (6.0")	756.4																	
0.5' - AGGREGATE BASE (6.0")	755.9																	
LOOSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, DAMP.	753.9	1 2	3 2 2	6	33	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
STIFF, BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.		3 4 5	4 9 8	23	39	SS-2	1.50	-	-	-	-	-	-	-	-	12	A-6a (V)	
-COBBLES PRESENT @ 5.0'	751.4	6 7	5 3 3	8	33	SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
LOOSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, MOIST.	748.9	8 9	WOH 7 7	19	72	SS-4	0.50	8	7	10	46	29	36	19	17	23	A-6b (11)	
SOFT, BROWN **SILTY CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.	746.4	10 11 12	5 7 8	21	67	SS-5	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
MEDIUM DENSE TO VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST.		13 14 15	8 16 15	43	61	SS-6	-	32	39	11	15	3	19	17	2	7	A-1-b (0)	
		16 17	8 17 20	51	61	SS-7	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		18 19 20	18 16 13	40	72	SS-8	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		21 22 23	18 12 14	36	83	SS-9	-	42	30	10	13	5	NP	NP	NP	8	A-1-b (0)	
		24 25	6 10 13	32	72	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		26 27 28	5 10 12	30	78	SS-11	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
-STONE FRAGMENTS PRESENT THROUGHOUT		29	8 11 16	37	67	SS-12	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 3/14/15 17:35 - U:\GI8\PROJECTS\2013\W-13-045.GPJ

PID: 77372	BR ID: FRA-70-1390	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5091+04.93 / 11.5 LT	START: 8/21/13	END: 8/22/13	PG 2 OF 3	B-026-3-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	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 TO VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST. *(same as above)*	726.9																	
	724.9																	
HARD, GRAY **SANDY SILT**, LITTLE CLAY, LITTLE FINE GRAVEL, DAMP.		31																
		32																
		33																
		34	10 22 24	63	83	SS-13	4.5+	15	11	17	38	19	21	14	7	9	A-4a (4)	
		35																
		36 W																
	719.9	37																
VERY DENSE, BROWN TO BROWNISH GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.		38																
		39	11 26 26	72	83	SS-14	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		40																
		41																
		42																
		43																
		44	8 29 50	109	83	SS-15	-	52	14	17	14	3	17	14	3	11	A-1-b (0)	
		45																
		46																
		47																
		48																
		49	10 20 28	66	56	SS-16	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		50																
		51																
	704.9	52																
HARD, GRAY **SANDY SILT**, LITTLE CLAY, LITTLE FINE GRAVEL, DAMP.		53																
		54	3 22 28	69	78	SS-17	4.5+	12	11	19	40	18	24	14	10	10	A-4a (5)	
		55																
		56																
		57																
		58																
		59	10 44 50/5"	-	88	SS-18	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
		60																
		61																
	694.9																	

PID: 77372	BR ID: FRA-70-1390	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5091+04.93 / 11.5 LT	START: 8/21/13	END: 8/22/13	PG 3 OF 3	B-026-3-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY DENSE, GRAY **GRAVEL WITH SAND AND SILT**, TRACE CLAY, WET. *(same as above)*	694.8	63																
		64	WOH 45 50/3"	-	40	SS-19	-	-	-	-	-	-	-	-	-	20	A-2-4 (V)	
	689.9	65																
VERY DENSE, GRAY TO DARK GRAY **GRAVEL AND SAND**, TRACE SILT, TRACE CLAY, MOIST.		66																
		67																
		68																
		69	8 22 28	69	44	SS-20	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		70																
		71																
		72																
		73																
		74	12 23 28	70	67	SS-21	-	38	28	23	10	1	13	10	3	13	A-1-b (0)	
		75																
		76																
		77																
		78																
		79	37 50/3"	-	33	SS-22	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		80																
		81																
		82																
		83																
		84	10 19 28	65	56	SS-23	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		85																
		86																
	669.9	87																
VERY DENSE, GRAY **COARSE AND FINE SAND**, LITTLE FINE GRAVEL, LITTLE SILT, TRACE CLAY, WET.		88																
		89	12 28 50	107	67	SS-24	-	11	30	39	18	2	NP	NP	NP	10	A-3a (0)	
	666.9	90																
		EOB																

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 36.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 376 LBS PORTLAND CEMENT / 100 LBS BENTONITE POWDER / 100 GAL WATER

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 PHASE 6A	DRILLING FIRM / OPERATOR: RII / S.B.	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 185+64.16 / 3.7' RT	**EXPLORATION ID B-026-4-19**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-70 WB	
PID: 89464 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/3/18	ELEVATION: 735.9 (MSL) EOB: 8.2 ft.	PAGE 1 OF 1
START: 1/23/20 END: 1/23/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.5	LAT / LONG: 39.953161, -83.001205	

MATERIAL DESCRIPTION AND NOTES	ELEV. 735.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.75' - ASPHALT (9.0")	735.1																		
0.75' - CONCRETE (9.0")	734.4																		
0.7' - AGGREGATE BASE (8.0")	733.7																		
STIFF, BROWN **SILTY CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST.	733.2		10 20 4	32	61	SS-1A	2.00	-	-	-	-	-	-	-	-	11	A-6b (V)	-	
						SS-1B	-	50	17	9	19	5	21	17	4	9	A-1-b (0)	310	
MEDIUM DENSE TO DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST.			23 17 12	38	61	SS-2	-	52	15	10	19	4	21	18	3	7	A-1-b (0)	-	
			11 12 14	34	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	-	
			9 9 10	25	61	SS-4	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	-	
	727.7	EOB																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS; PAVEMENT PATCHED WITH CONCRETE.

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 PHASE 6A	DRILLING FIRM / OPERATOR: RII / S.B.	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 189+00.00 / 10' LT	**EXPLORATION ID B-027-2-19**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-70 WB	
PID: 89464 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/3/18	ELEVATION: 729.6 (MSL) EOB: 7.9 ft.	PAGE 1 OF 1
START: 1/20/20 END: 1/20/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.5	LAT / LONG: 39.953130, -83.000009	

MATERIAL DESCRIPTION AND NOTES	ELEV. 729.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.65' - ASPHALT (8.0")	728.9																		
0.65' - CONCRETE (8.0")	728.3																		
0.5' - AGGREGATE BASE (7.0")	727.7																		
MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP.	726.2	1	17 17 16	44	39	SS-1	-	45	24	12	15	4	NP	NP	NP	4	A-1-b (0)	3800	
MEDIUM DENSE TO DENSE, GRAY **COARSE AND FINE SAND**, LITTLE SILT, TRACE FINE GRAVEL, TRACE CLAY, MOIST.		2	8 10 11	28	78	SS-2	-	8	25	53	13	1	NP	NP	NP	5	A-3a (0)	-	
		3	10 12 14	34	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-3a (V)	-	
		4	13 14 16	40	67	SS-4	-	-	-	-	-	-	-	-	-	14	A-3a (V)	-	
	721.7	5 EOB																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS; PAVEMENT PATCHED WITH CONCRETE.

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

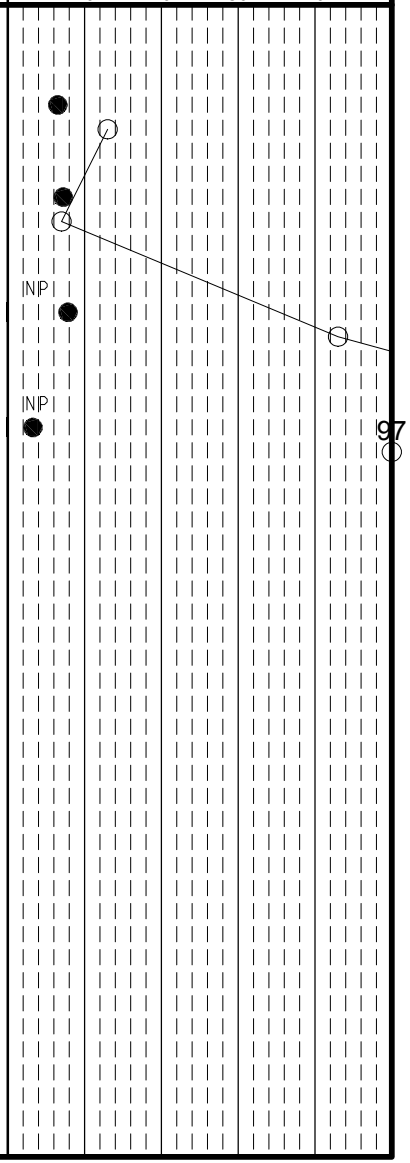
LOG OF: Boring B-028-0-08 | *Location:* Sta. 191+29.78, 14.9' LT., BL I-70 WB | *Date Drilled:* 7/24/2008

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None

FIELD NOTES:
Advanced boring using 3.25" diameter hollowstem augers.

Depth (ft)	Elev. (ft) 731.7	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
1.5	730.2						Asphalt Concrete - 12" Aggregate Base - 6"							
		8 6 7	8	1			FILL: Loose to medium dense brown GRAVEL (A-1-a), little to some fine to coarse sand, little silty clay; moist.		65	16	---	6	--13--	
5		4 5 2	7	2					70	14	---	5	--11--	
6.0	725.7													
		10 20 22	16	3			FILL: Dense brown GRAVEL WITH SAND (A-1-b), little silt; contains brick fragments and silty clay seams; damp.		34	35	---	14	--17--	
8.5	723.2													
10.0	721.7	47 49 46	12	4			FILL: Very dense gray GRAVEL (A-1-a), trace fine to coarse sand; contains few silty clay seams; damp.		84	5	---	3	--8--	
10							Bottom of Boring - 10.0'							
15														
20														
25														

STANDARD PENETRATION (N60)
Natural Moisture Content, % - ●
PL ⊢——⊣ *LL*
Blows per foot - ○ / *Non-Plastic -* NP



RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 PHASE 6A	DRILLING FIRM / OPERATOR: RII / S.B.	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 193+00.00 / 10' LT	**EXPLORATION ID B-029-1-19**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-70 WB	
PID: 89464 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/3/18	ELEVATION: 735.7 (MSL) EOB: 7.9 ft.	PAGE 1 OF 1
START: 1/20/20 END: 1/20/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.5	LAT / LONG: 39.953187, -82.998590	

MATERIAL DESCRIPTION AND NOTES	ELEV. 735.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.4' - ASPHALT (5.0")	735.3																		
1.0' - CONCRETE (12.0")	734.3																		
0.5' - AGGREGATE BASE (6.0")	733.8																		
HARD, BROWN **SANDY SILT**, SOME CLAY, TRACE TO LITTLE FINE GRAVEL, DAMP.		1																	
		2	12 13 14	36	50	SS-1	4.5+	15	8	14	40	23	23	14	9	10	A-4a (6)	540	
		3																	
		4	5 10 12	29	89	SS-2	4.5+	7	12	14	40	27	23	14	9	10	A-4a (6)	-	
		5	12 20 17	49	78	SS-3	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	-	
		6																	
	727.8	7 EOB	17 16 16	42	100	SS-4	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	-	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 50 LBS BENTONITE CHIPS AND SOIL CUTTINGS; PAVEMENT PATCHED WITH CONCRETE.

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

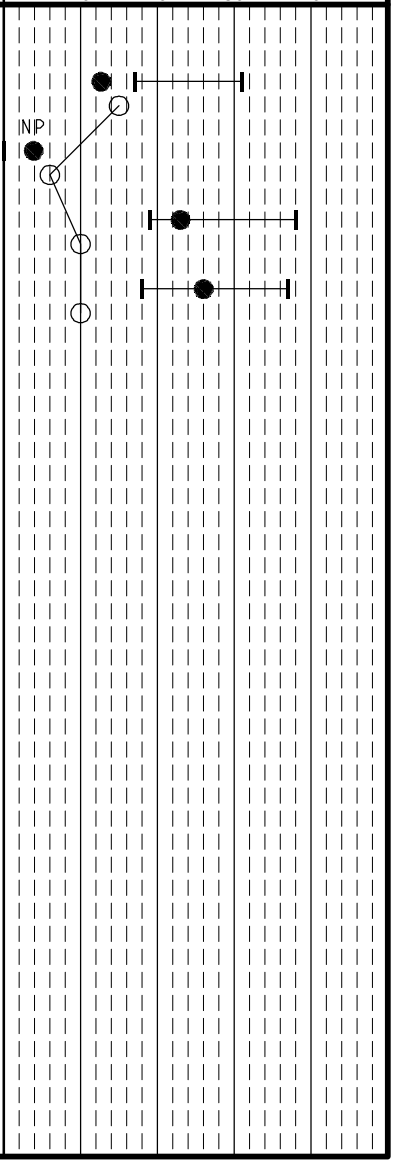
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-091-0-09 | *Location:* Sta. 3000+68.95, 10.2' LT., BL RAMP B3 | *Date Drilled:* 9/1/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	705.2													
1.0	704.2						Asphalt Concrete - 4" Portland Cement Concrete - 8"							
2.5	702.7	8 8 7	18	1		-	FILL: Hard brown SILT AND CLAY (A-6a), some fine to coarse sand, some gravel; damp.		21	14	---	12	31	22
4.0	701.2	14 3 3	12	2			POSSIBLE FILL: Loose brown GRAVEL WITH SAND (A-1-b), trace silt; damp.		48	40	---	5	--7--	
5		6 5 5	18	3		2.25	Stiff to very stiff brown SILTY CLAY (A-6b), little fine to coarse sand; damp.		0	1	---	15	44	40
7.0	698.2	4 5 5	18	4		1.75			0	1	---	14	45	40
							Bottom of Boring - 7.0'							
10														
15														
20														
25														

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL ——— *LL*
Blows per foot - ○ / *Non-Plastic -* NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

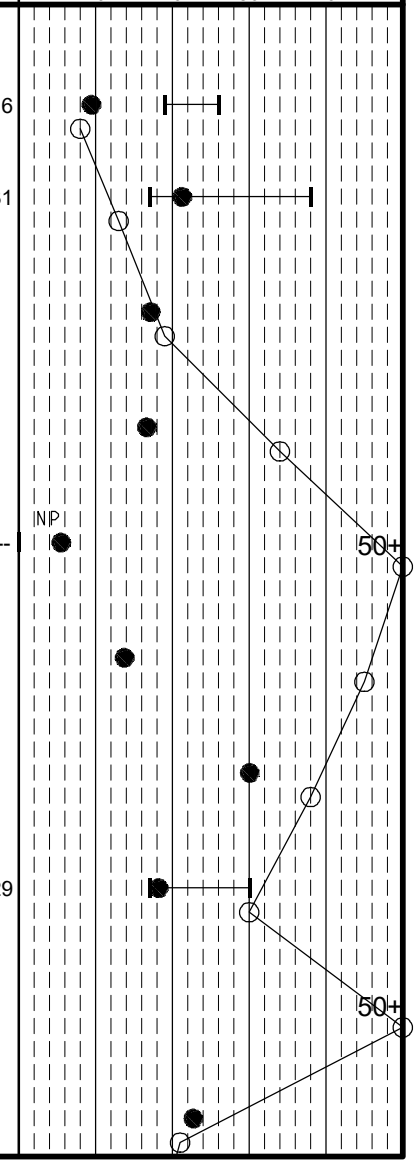
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-092-0-09 | *Location:* Sta. 685+49.50, 79.6' LT., BL I-71 NB | *Date Drilled:* 9/1/2009 to 9/9/2009

WATER OBSERVATIONS:
Water seepage at: 38.5'
Water level at completion: 37.1'
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	724.9													
1.5	723.4						Asphalt Concrete - 8" Aggregate Base - 10"							
		7 4 4	5	1		--	FILL: Very stiff brown SANDY SILT (A-4a), "and" gravel, some fine to coarse sand; damp.		36	17	---	11	20	16
3.5	721.4													
5		8 7 6	12	2		2.0	FILL: Very stiff brown SILTY CLAY (A-6b), some fine to coarse sand, some gravel; moist.		22	9	---	14	24	31
		11 8 11	13	3		2.0								
10		11 17 16	14	4		2.5	@ 8.5'-10.0', contains numerous gravel fragments.							
11.0	713.9													
		8 10 50/5	6	5			FILL: Very dense brown and gray GRAVEL (A-1-a), some fine to coarse sand, little silt; damp.		60	17	---	11	--12--	
13.5	711.4													
15		12 22 22	15	6		--	FILL: Hard brown SANDY SILT (A-4a), some fine to coarse sand, some gravel; contains numerous gravel fragments; damp.							
16.0	708.9													
		18 20 17	17	7		3.5	Very stiff to hard dark brown SILT AND CLAY (A-6a), some fine to coarse sand, trace to little gravel; damp to moist.							
20		15 13 16	18	8		4.5			10	13	---	11	37	29
		50/6	0	9		--								
		9 10 11	13	10		3.25								
25	699.9													

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

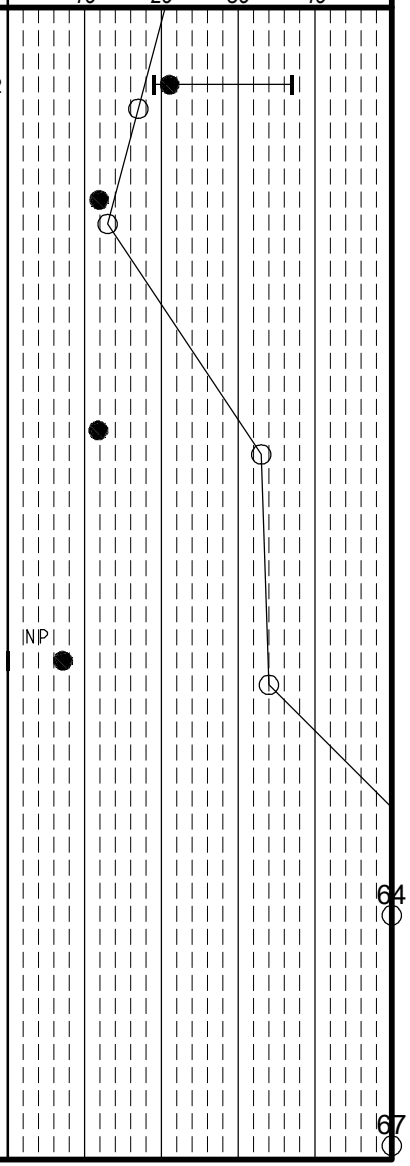
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-092-0-09 | *Location:* Sta. 685+49.50, 79.6' LT., BL I-71 NB | *Date Drilled:* 9/1/2009 to 9/9/2009

WATER OBSERVATIONS:
Water seepage at: 38.5'
Water level at completion: 37.1'
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	699.9						Very stiff brown SILTY CLAY (A-6b), little fine to coarse sand, trace gravel; damp to moist.							
		10 8 9	12	11		3.25			0	0	---	13	45	42
		6 7 6	1	12		--								
30							Note: terminated sampling on 9/2/09 @ 30.0 feet. Resumed sampling on 9/9/09.							
32.0	692.9						Very stiff brown SANDY SILT (A-4a), "and" gravel; damp.							
		3 14 18	11	13		3.75								
35														
37.0	687.9						Dense to very dense brown GRAVEL (A-1-a), trace fine to coarse sand, trace silt; wet.							
		13 13 20	10	14					87	6	---	3	--4--	
40														
		18 32 31	8	15										
45														
47.0	677.9						Very dense gray GRAVEL WITH SAND (A-1-b), little silt; wet.							
		36 33 33	12	16										
50.0	674.9						Bottom of Boring - 50.0'							

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

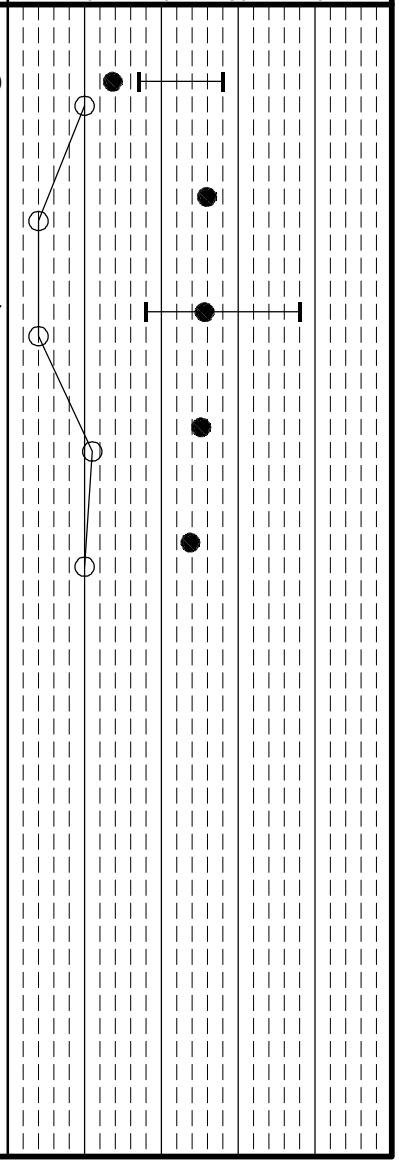
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-094-0-09 | *Location:* Sta. 3003+86.72, 8.6' LT., BL RAMP B3 | *Date Drilled:* 9/1/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	713.4													
1.3	712.1	5 5 5	10	1		2.0	Portland Cement Concrete - 9" Aggregate Base - 6" POSSIBLE FILL: Stiff brown SILT AND CLAY (A-6a), "and" fine to coarse sand, little gravel; damp.		12	20	---	18	30	20
3.5	709.9													
5		3 2 2	18	2		1.25	Stiff brown SILTY CLAY (A-6b), trace to little fine to coarse sand, trace gravel; moist.							
		5 2 2	5	3		1.0			4	4	---	11	44	37
10		6 5 6	4	4		1.5								
12.5	700.9	7 5 5	18	5		1.5								
							Bottom of Boring - 12.5'							
15														
20														
25														

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



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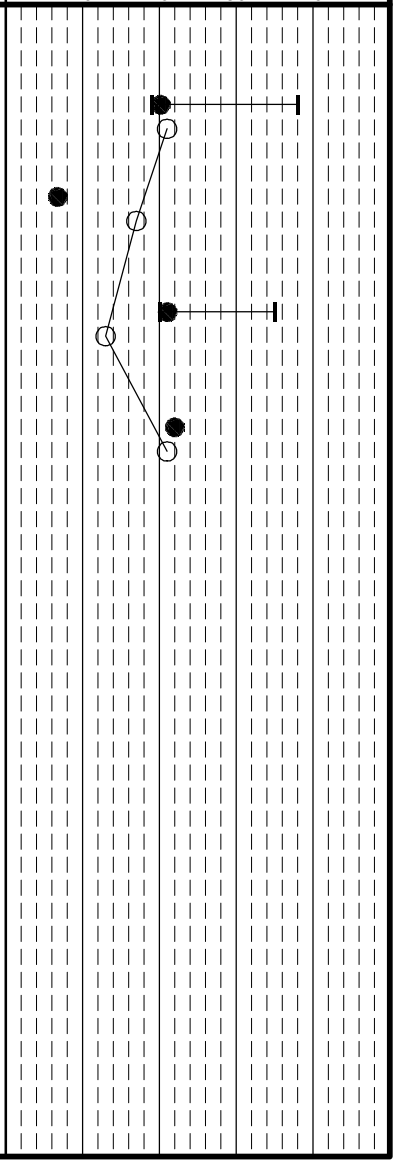
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-095-0-09 | *Location:* Sta. 203+05.61, 121.3' RT., BL I-71 NB | *Date Drilled:* 9/2/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	718.0													
1.3	716.7						Asphalt Concrete - 7" Portland Cement Concrete - 9"							
3.5	714.5	7 6 14	15	1		2.0	POSSIBLE FILL: Stiff to very stiff brown SILTY CLAY (A-6b), little fine to coarse sand, little gravel; contains rock fragments; moist.		13	6	---	7	39	35
6.0	712.0	9 10 6	7	2			POSSIBLE FILL: Medium dense brown SANDY SILT (A-4a), some fine to coarse sand, little gravel; damp.							
		4 4 9	18	3		1.0	POSSIBLE FILL: Stiff brownish gray SILT AND CLAY (A-6a), little fine to coarse sand, little gravel; damp to moist.		13	7	---	8	38	34
10.0	708.0	11 11 9	18	4		2.0								
							Bottom of Boring - 10.0'							

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

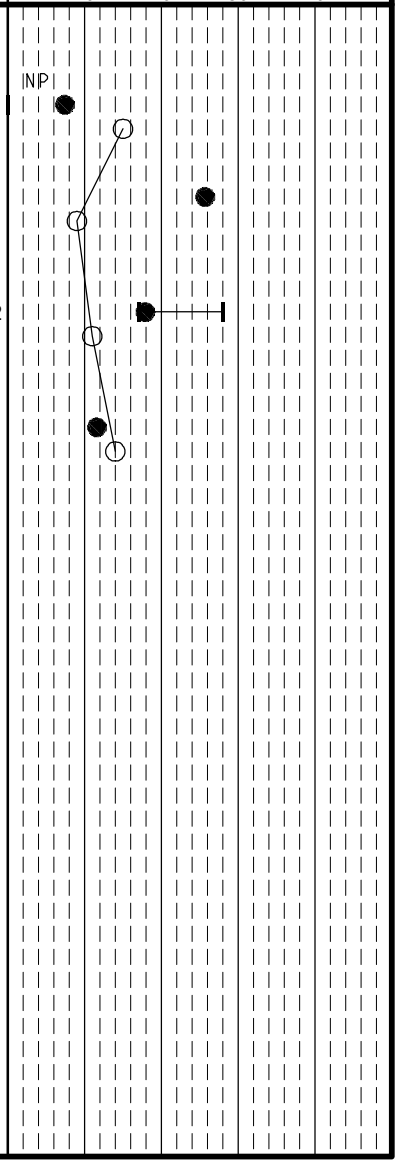
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-096-1-09 | *Location:* Sta. 206+96.35, 14.0' RT., BL I-71 NB | *Date Drilled:* 9/1/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft) 713.8	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0.9	712.9						Asphalt Concrete - 6" Aggregate Base - 5"							
		6 7 8	13	1			POSSIBLE FILL: Medium dense brown GRAVEL WITH SAND (A-1-b), little silt; damp to moist.		20	48	---	19	--13--	
3.5	710.3													
5		2 3 6	8	2		1.75	Stiff brown SILT AND CLAY (A-6a), some fine to coarse sand, little gravel; damp to moist.							
		2 3 8	10	3		1.0			16	9	---	15	38	22
8.5	705.3													
10.0	703.8	8 6 8	3	4			Medium dense brown GRAVEL WITH SAND, SILT, AND CLAY (A-2-6); damp.							
10							Bottom of Boring - 10.0'							
15														
20														
25														

STANDARD PENETRATION (N60)
Natural Moisture Content, % - ●
PL ⊢ LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

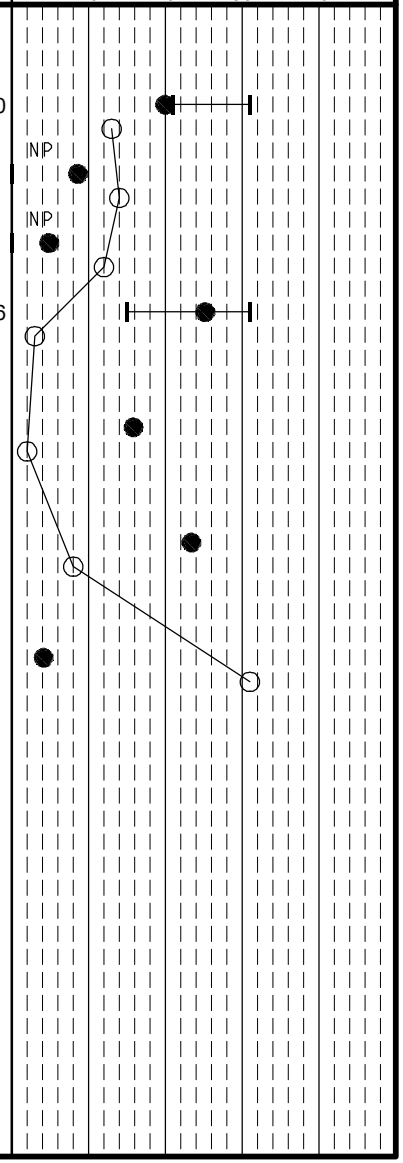
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-097-0-09 | *Location:* Sta. 210+75.17, 143.2' RT., BL I-71 NB | *Date Drilled:* 9/2/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	720.2													
1.7	718.5						Asphalt Concrete - 4" Portland Cement Concrete - 10" Aggregate Base - 6"							
3.0	717.2	17 7 6	12	1		--	FILL: Stiff brown SANDY SILT (A-4a), "and" fine to coarse sand, trace to little gravel; contains trace asphalt and brick fragments; damp.		10	17	---	22	31	20
4.5	715.7	10 8 6	12	2			FILL: Medium dense brown GRAVEL WITH SAND (A-1-b), little silt, trace clay; damp.		40	25	---	13	13	9
6.0	714.2	9 7 5	10	3			FILL: Medium dense brown GRAVEL (A-1-a), some fine to coarse sand, trace silt; damp.		70	15	---	6	--9--	
8.5	711.7	3 1 2	10	4		0.75	FILL: Medium stiff brown SILTY CLAY (A-6b), "and' fine to coarse sand, trace gravel; contains cinders; damp to moist.		8	8	---	34	24	26
10		4 1 1	18	5		0.5	Medium stiff brown SILT AND CLAY (A-6a), little to some fine to coarse sand, trace gravel; damp to moist.							
		4 5 3	18	6		0.75								
13.5	706.7													
15.0	705.2	35 19 11	15	7			Very dense brown GRAVEL WITH SAND (A-1-b), little silt, damp.							
							Bottom of Boring - 15.0'							

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

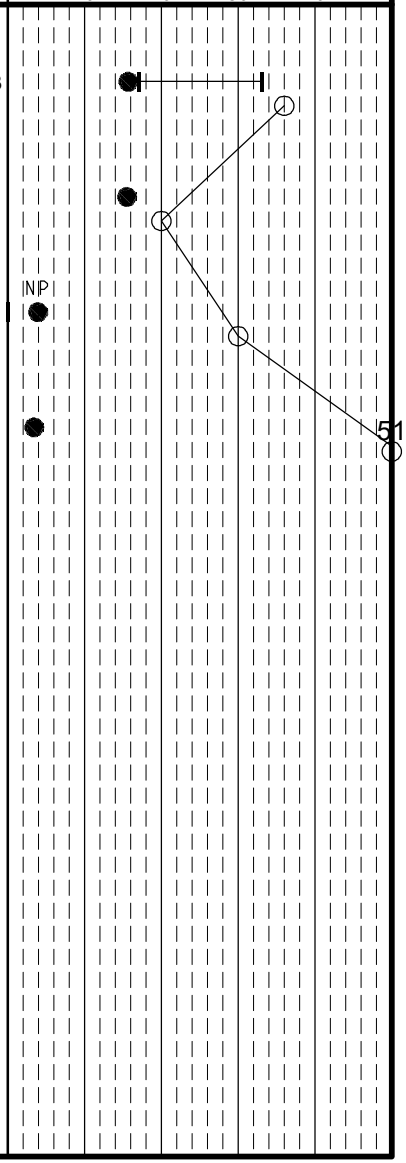
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-098-1-09 | *Location:* Sta. 214+88.38, 15.1' RT., BL I-71 NB | *Date Drilled:* 9/1/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft) 718.6	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
							Asphalt Concrete - 5" Aggregate Base - 13"							
1.5	717.1	12 17 18	15	1		2.0	FILL: Stiff to very stiff brown SILTY CLAY (A-6b), some gravel, little fine to coarse sand; damp.		35	11	---	8	23	23
3.5	715.1													
5		10 8 11	18	2		3.5	FILL: Very stiff brown SANDY SILT (A-4a), little gravel; contains few brick fragments; damp.							
6.0	712.6													
		11 12 17	7	3			POSSIBLE FILL: Dense to very dense brown GRAVEL (A-1-a), little fine to coarse sand, little silt; damp.		73	10	---	5	--12--	
		49 27 22	4	4										
10.0 10	708.6						Bottom of Boring - 10.0'							
15														
20														
25														

STANDARD PENETRATION (N60)
Natural Moisture Content, % - ●
PL ⊢——⊣ *LL*
Blows per foot - ○ / *Non-Plastic -* NP
10 20 30 40



DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

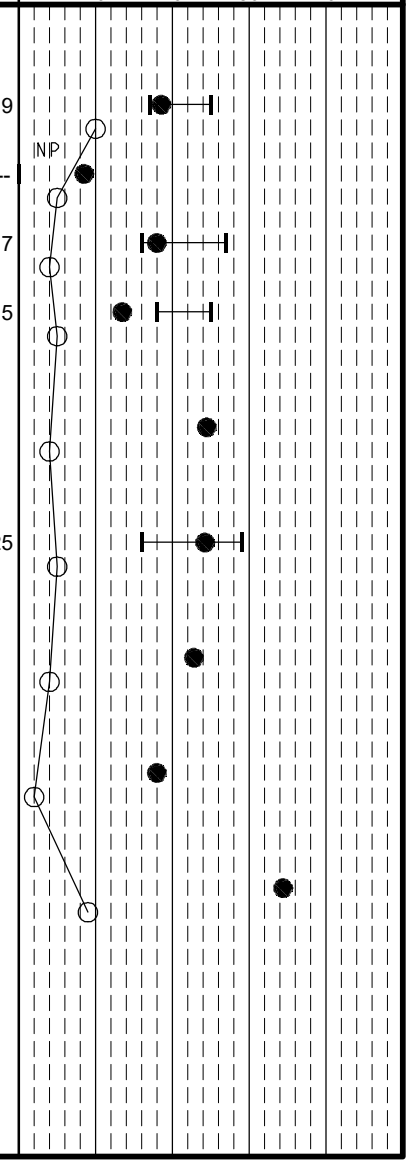
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-099-0-09 | *Location:* Sta. 218+98.88, 143.2' RT., BL I-71 NB | *Date Drilled:* 9/2/2009

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: None
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	722.1													
1.3	720.8						Asphalt Concrete - 5" Portland Cement Concrete - 10"							
3.0	719.1	7 4 6	10	1			FILL: Medium dense brown SANDY SILT (A-4a), little gravel; contains brick fragments; moist.		11	13	---	37	20	19
4.5	717.6	8 3 2	10	2			FILL: Loose brown GRAVEL WITH SAND (A-1-b), little silt; damp.		44	19	---	20	--17--	
6.0	716.1	2 2 2	18	3		1.0	FILL: Medium stiff to stiff brown SILT AND CLAY (A-6a), "and" fine to coarse sand, little gravel; contains asphalt, brick, and coal fragments; damp.		15	15	---	28	25	17
8.5	713.6	2 3 2	8	4		0.75	FILL: Medium stiff brown SANDY SILT (A-4a), some gravel; damp.		21	26	---	21	17	15
11.0	711.1	2 2 2	15	5		0.75	Medium stiff brown SANDY SILT (A-4a), trace to little gravel; moist.							
		WOH 2 3	6	6		0.5	Medium stiff gray SILT AND CLAY (A-6a), some to "and" fine to coarse sand, trace to little gravel; moist.		5	6	---	31	33	25
		2 2 2	9	7		0.5								
		2 1 1	9	8		0.75								
20.0	702.1	2 2 7		9		0.75								
							Bottom of Boring - 20.0'							

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL — LL
Blows per foot - ○ / Non-Plastic - NP
10 20 30 40



RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: STOCK / T.B./B.Z.	DRILL RIG: BK 81 HD (SN 810792.111)	STATION / OFFSET: 221+70.29 / 44.7' RT	**EXPLORATION ID B-099-4-14**
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / D.M.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-71 SB	
PID: 89464 BR ID: N/A	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 3/28/13	ELEVATION: 717.0 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 4/14/15 END: 4/14/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 72.3	LAT / LONG: 39.945765, -83.014005	

MATERIAL DESCRIPTION AND NOTES	ELEV.	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
0.3' - ASPHALT (3.0")	717.0																	
0.7' - CONCRETE (9.0")	716.7																	
VERY STIFF, BROWN **CLAY**, SOME SILT, SOME FINE GRAVEL, LITTLE COARSE TO FINE SAND, DAMP.	716.0		9 7 5	14	44	SS-1	2.50	-	-	-	-	-	-	-	-	12	A-7-6 (V)	
			5 8 6	17	78	SS-2	2.50	36	12	6	25	21	43	18	25	17	A-7-6 (7)	
-ROCK FRAGMENTS PRESENT THROUGHOUT			20 24 24	58	78	SS-3	2.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
	706.5																	
VERY STIFF, BROWN AND BLACK **SILT AND CLAY**, SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP.	704.0		9 9 15	29	94	SS-4	3.00	-	-	-	-	-	-	-	-	13	A-7-6 (V)	
			7 8 9	20	50	SS-5	3.00	33	11	14	26	16	34	19	15	16	A-6a (3)	
MEDIUM DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-6	702.0	EOB	4 6 17	28	11	SS-6	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER SOIL CUTTINGS

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-100-0-09 | *Location:* Sta. 222+98.38, 5.9' RT., BL I-71 NB | *Date Drilled:* 9/1/2009

WATER OBSERVATIONS:
Water seepage at: 3.0'
Water level at completion: 13.4'
FIELD NOTES:

Depth (ft)	Elev. (ft) 716.6	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N60) Natural Moisture Content, % - ● PL — LL Blows per foot - ○ / Non-Plastic - NP
0.8	715.8						Asphalt Concrete - 5" Aggregate Base - 5"								
		9 5 4	10	1			POSSIBLE FILL: Loose brown GRAVEL (A-1-a), some fine to coarse sand, trace to little silt; damp to moist.								NP
		5 2 5	4	2					68	17	---	6	--9--		NP
5		3 2 5	2	3					63	12	---	8	--17--		
6.0	710.6	4 23 32	12	4		1.0	Stiff gray SANDY SILT (A-4a), some fine to coarse sand, some gravel; moist.		21	11	---	15	30	23	57
7.5	709.1	17 28 8	12	5			Very dense gray GRAVEL WITH SAND (A-1-b), little silt; damp.		45	25	---	14	--16--		NP
9.0	707.6	3 6 5	6	6		2.0	Stiff brown SILTY CLAY (A-6b), little to some fine to coarse sand, little gravel; contains rock fragments; damp to moist.		19	15	---	9	27	30	
10		6 18 12	10	7		1.0									
		8 13 24	5	8		1.0									
15.0	701.6						Bottom of Boring - 15.0'								
20															
25															

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.K.	DRILL RIG: CME-55 (SN 386345)	STATION / OFFSET: 245+03.67 / 17.9' LT	**EXPLORATION ID B-113-2-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / N.A.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-71 SB		
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 10/20/14	ELEVATION: 743.3 (MSL) EOB: 99.2 ft.		PAGE 1 OF 4
START: 1/15/15 END: 1/22/15	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 92	LAT / LONG: 39.951551, -83.015294		

MATERIAL DESCRIPTION AND NOTES	ELEV. 743.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.7' - ASPHALT (8.0")	742.6																	
0.5' - AGGREGATE BASE (6.0")	742.1																	
MEDIUM DENSE TO VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST.		1																
		2																
		3																
		4	4 19 13	48	83	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		5																
		6																
		7																
		8																
		9	30 15 50/2"	-	57	SS-2	-	54	17	10	11	8	21	15	6	7	A-1-b (0)	
		10																
		11																
		12																
		13																
		14	24 26 23	74	100	SS-3	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		15																
		16																
		17																
		18																
		19	14 4 6	15	0	SS-4	-	-	-	-	-	-	-	-	-	-		
	721.3	20																
DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP.		21																
		22																
		23																
		24	31 15 17	48	50	SS-5	-	40	22	14	14	10	22	15	7	8	A-2-4 (0)	
	716.3	25																
VERY STIFF TO HARD, BROWN AND GRAY TO REDDISH BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DRY TO MOIST.		26																
		27																
		28																
-ROCK FRAGMENTS PRESENT IN SS-6		29	9 9 15	36	100	SS-6	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	

2014 ODOT BORING LOG-RII NE BRIDGE ID - OH DOT.GDT - 7/12/19 13:01 - U:\GI\8\PROJECTS\2013\W-13-072.GPJ

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 245+03.67 / 17.9 LT	START: 1/15/15	END: 1/22/15	PG 2 OF 4	B-113-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY STIFF TO HARD, BROWN AND GRAY TO REDDISH BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DRY TO MOIST. *(same as above)*	713.3																	
			50/3"	-	0	SS-7	-	-	-	-	-	-	-	-	-	-		
			34 7 8	23	67	SS-8	2.50	6	16	14	32	32	30	18	12	20	A-6a (7)	
			34 17 7	36	56	SS-9	3.25	-	-	-	-	-	-	-	-	20	A-6a (V)	
	702.8																	
MEDIUM DENSE TO VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO WET. -ROCK FRAGMENTS PRESENT IN SS-10			14 19 23	63	89	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
			17 7 10	26	100	SS-11	-	33	27	18	14	8	NP	NP	NP	7	A-1-b (0)	
-ROCK FRAGMENTS PRESENT IN SS-12			28 26 22	72	100	SS-12	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			17 19 29	72	100	SS-13	-	46	20	10	19	5	22	19	3	9	A-1-b (0)	
			27 28 31	89	100	SS-14	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		W	8 9 21	45	100	SS-15	-	-	-	-	-	-	-	-	-	20	A-1-b (V)	
	686.3																	
VERY DENSE, GRAYISH BROWN **GRAVEL**, SOME COARSE TO FINE SAND, LITTLE SILT, TRACE CLAY, MOIST.			26 41 37	117	100	SS-16	-	60	19	8	11	2	17	15	2	7	A-1-a (0)	
	681.3																	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 245+03.67 / 17.9 LT	START: 1/15/15	END: 1/22/15	PG 3 OF 4	B-113-2-13

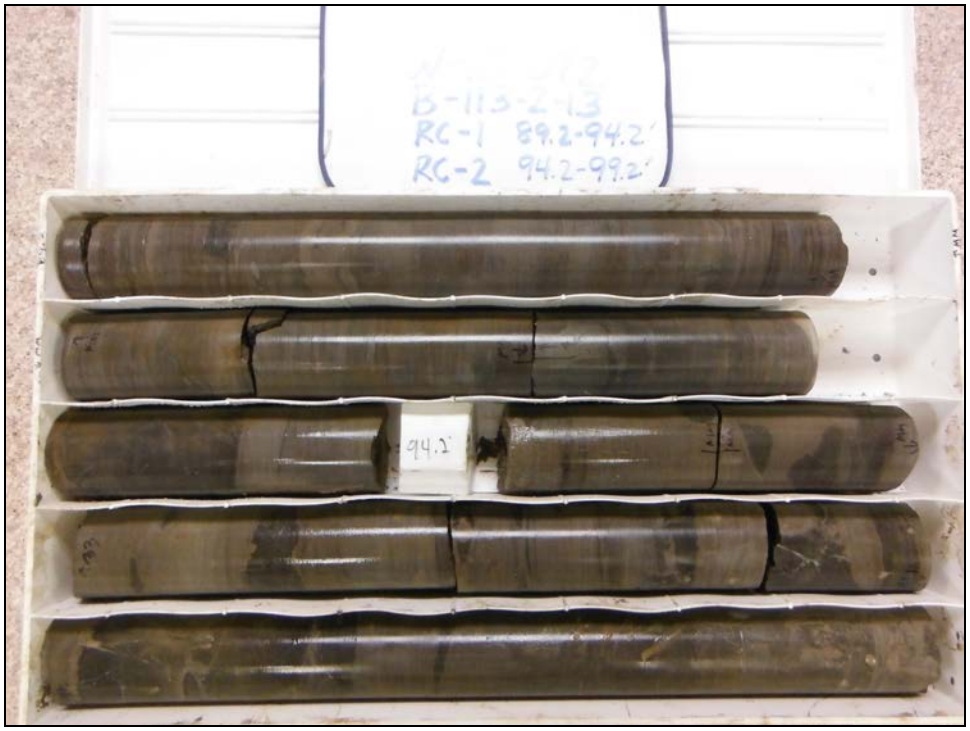
MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAYISH BROWN **COARSE AND FINE SAND**, SOME SILT, LITTLE CLAY, MOIST. *(same as above)*	681.2	63																
		64	27 50/5"	-	100	SS-17	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
		65																
		66																
	676.3	67																
HARD, BROWNISH GRAY **SANDY SILT**, LITTLE CLAY, LITTLE FINE GRAVEL, DAMP.		68																
		69	29 41 48	134	100	SS-18	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
		70																
		71																
		72																
		73																
		74	13 14 23	56	100	SS-19	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		75																
		76																
		77																
		78																
-ROCK FRAGMENTS PRESENT THROUGHOUT		79	17 23 44	101	50	SS-20	4.5+	13	13	17	40	17	20	13	7	11	A-4a (4)	
		80																
		81																
		82																
		83																
		84	30 50/3"	-	78	SS-21	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
		85																
		86																
		87																
		88																
	654.1	89	35 50/2"	-	88	SS-22	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
LIMESTONE : BROWNISH GRAY, UNWEATHERED, SLIGHTLY STRONG TO STRONG, MEDIUM TO THICK BEDDED, CHERTY, DOLOMITIC, CRYSTALLINE, SLIGHTLY FRACTURED, NARROW APERTURES, SLIGHTLY ROUGH; RQD 90%, REC 91%. -QU @ 91.5' = 14,395 PSI		TR 90	84		85	RC-1												CORE	
		91																
		92																
		93																
		94																

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 245+03.67 / 17.9 LT	START: 1/15/15	END: 1/22/15	PG 4 OF 4	B-113-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
LIMESTONE : BROWNISH GRAY, UNWEATHERED, SLIGHTLY STRONG TO STRONG, MEDIUM TO THICK BEDDED, CHERTY, DOLOMITIC, CRYSTALLINE, SLIGHTLY FRACTURED, NARROW APERTURES, SLIGHTLY ROUGH; RQD 90%, REC 91%. *(same as above)* -CHERTY FROM @ 95.5' TO 99.2'	649.0	95 96 97 98	97		97	RC-2											CORE	
	644.1	EOB 99																

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 55.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 376 LBS CEMENT / 100 LBS BENTONITE CHIPS / 80 GAL WATER



B-113-2-13 – RC-1 and RC-2 – Depth from 89.2 to 99.2 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / T.F.	DRILL RIG: CME 750X (SN 310218)	STATION / OFFSET: 247+30.17 / 35.7' RT	**EXPLORATION ID B-113-3-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / C.D.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-71 SB		
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/20/14	ELEVATION: 735.3 (MSL) EOB: 91.0 ft.		PAGE 1 OF 3
START: 1/15/15 END: 1/16/15	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 85.7	LAT / LONG: 39.951860, -83.014577		

MATERIAL DESCRIPTION AND NOTES	ELEV. 735.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.5' - ASPHALT (6.0")	734.8																	
1.0' - AGGREGATE BASE (12.0")	733.8																	
FILL: MEDIUM DENSE, BROWN **COARSE AND FINE SAND**, LITTLE FINE GRAVEL, LITTLE SILT, TRACE CLAY, MOIST.	732.3	1	9 4 4	11	78	SS-1	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
FILL: VERY STIFF, GRAY **SANDY SILT**, SOME FINE GRVEL, LITTLE CLAY, DAMP.	728.3	4	2 5 9	20	72	SS-2	2.50	27	15	15	25	18	26	17	9	13	A-4a (2)	
FILL: DENSE TO VERY DENSE, BROWN **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP.	718.3	9	12 19 16	50	89	SS-3	-	-	-	-	-	-	-	-	-	7	A-2-4 (V)	
		14	14 16 14	43	83	SS-4	-	43	21	10	13	13	24	15	9	7	A-2-4 (0)	
FILL: VERY STIFF, BROWN AND GRAY **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.		19	4 5 8	19	67	SS-5	2.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
-CINDERS AND ORGANICS PRESENT IN SS-6	712.3	22	10 10 11	30	78	SS-6	4.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
FILL: STIFF TO VERY STIFF, BROWN **SILTY CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP. -SLAG AND COAL FRAGMENTS PRESENT IN SS-7		24	3 3 5	11	67	SS-7	2.00	9	4	24	29	34	36	20	16	16	A-6b (8)	
-SHELLS PRESENT IN SS-8	707.3	27	5 6 9	21	67	SS-8	3.00	-	-	-	-	-	-	-	-	19	A-6b (V)	
VERY DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, DRY.		29	50/3"	-	67	SS-9	-	-	-	-	-	-	-	-	-	3	A-1-a (V)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 247+30.17 / 35.7 RT	START: 1/15/15	END: 1/16/15	PG 2 OF 3	B-113-3-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 705.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	704.8																	
STIFF TO HARD, DARK BROWNISH GRAY TO BROWN **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, MOIST.		31	2 2 7	13	89	SS-10	2.00	-	-	-	-	-	-	-	-	28	A-6a (V)	
		32																
		33																
		34	8 11 13	34	89	SS-11	4.5+	0	2	18	37	43	34	19	15	21	A-6a (10)	
		35																
		36	9 12 12	34	67	SS-12	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	
	697.3	37																
DENSE TO VERY DENSE, BROWN **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.		38																
		39	11 16 9	36	28	SS-13	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		40																
		41																
		42																
		43																
		44	10 16 20	51	44	SS-14	-	29	47	13	6	5	NP	NP	NP	18	A-1-b (0)	
W		45																
		46																
	688.3	47																
LOOSE TO MEDIUM DENSE, BROWN **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST TO WET.		48																
		49	2 5 6	16	56	SS-15	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		50																
		51																
		52																
		53																
		54	WOH 1 5	9	89	SS-16	-	23	52	15	6	4	NP	NP	NP	36	A-1-b (0)	
		55																
		56																
	678.3	57																
STIFF TO HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, MOIST.		58																
		59	5 7 9	23	0	SS-17	-	-	-	-	-	-	-	-	-	-		
W		60	14	-	100	3S-17A	1.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		61																

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 247+30.17 / 35.7 RT	START: 1/15/15	END: 1/16/15	PG 3 OF 3	B-113-3-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
STIFF TO HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, MOIST. *(same as above)*	673.2	63																
		64	14 23 19	60	0	SS-18	-	-	-	-	-	-	-	-	-	-		
		65	37	-	100	3S-18A	2.00	-	-	-	-	-	-	-	-	13	A-4a (V)	
		66																
		67																
		68																
		69	50/5"	-	100	SS-19	-	29	15	19	21	16	19	12	7	15	A-4a (0)	
		70																
		71																
	663.3	72																
VERY DENSE, GRAY **COARSE AND FINE SAND**, SOME FINE GRAVEL, LITTLE SILT, TRACE CLAY, MOIST.		73																
		74	27 50/2"	-	100	SS-20	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
	658.3	75																
		76																
SHALE : GRAY, HIGHLY WEATHERED, VERY WEAK.		77 TR																
		78																
		79	28 29 50/3"	-	80	SS-21	-	-	-	-	-	-	-	-	-	13	Rock (V)	
	653.3	80																
LIMESTONE : BROWNISH GRAY, UNWEATHERED, MODERATELY STRONG TO STRONG, THICK TO VERY THICK BEDDED, CHERTY, DOLOMITIC, PYRITIC, CRYSTALLINE, SLIGHTLY FRACTURED, NARROW APERTURES, SLIGHTLY ROUGH; RQD 93%, REC 95%.		81																
		82																
		83																
		84	98		98	RC-1											CORE	
		85																
		86																
-QU @ 87.8' = 5,882 PSI		87																
		88	87		92	RC-2											CORE	
		89																
		90																
	644.3	91 EOB																

NOTES: SEEPAGE ENCOUNTERED @ 44.5'; GROUNDWATER ENCOUNTERED INITIALLY @ 60.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER; PLACED CONCRETE

B-113-3-13 – RC-1 and RC-2 – Depth from 81.0 to 91.0 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.B.	DRILL RIG: CME-750 (SN 98048)	STATION / OFFSET: 271+12.84 / 28.4' RT	**EXPLORATION ID B-114-7-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / T.F./K.S	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-71 SB		
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 4/26/13	ELEVATION: 713.3 (MSL) EOB: 84.0 ft.		PAGE 1 OF 3
START: 2/4/14 END: 2/14/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 82.6	LAT / LONG: 39.953782, -83.006602		

MATERIAL DESCRIPTION AND NOTES	ELEV. 713.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.2' - TOPSOIL (2.0")	713.1																	
VERY STIFF, BROWN **SILT AND CLAY**, SOME FINE GRAVEL, SOME COARSE TO FINE SAND, DAMP. -ROCK FRAGMENTS PRESENT THROUGHOUT		1	5 7 30	51	83	SS-1	3.25	32	14	13	22	19	33	19	14	12	A-6a (2)	
-IRON STAINING PRESENT IN SS-2	707.8	4	9 11 4	21	61	SS-2	3.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
VERY STIFF, BROWN **CLAY**, AND SILT, TRACE FINE SAND, TRACE FINE GRAVEL, MOIST. -IRON STAINING PRESENT THROUGHOUT		6	1 4 4	11	44	SS-3	3.00	2	0	8	43	47	41	20	21	22	A-7-6 (13)	
		9	3 5 8	18	67	SS-4	3.25	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
	700.3	12	8 9 9	25	89	SS-5	2.75	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
LOOSE, BROWN **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST. -COBBLES PRESENT @ 15.0'	697.8	14	3 3 3	8	94	SS-6	-	30	19	21	12	18	34	17	17	14	A-2-6 (1)	
MEDIUM DENSE TO DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		W 16 W 17	5 9 13	30	56	SS-7	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
		19	6 8 8	22	67	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
-ROCK FRAGMENTS PRESENT THROUGHOUT		22	7 8 7	21	78	SS-9	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
		24	8 10 12	30	72	SS-10	-	69	12	6	8	5	NP	NP	NP	14	A-1-a (0)	
	685.3	27	7 10 18	39	83	SS-11	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
VERY DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		29	41 50/4"	-	60	SS-12	-	-	-	-	-	-	-	-	-	8	A-1a (V)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 271+12.84 / 28.4 RT	START: 2/4/14	END: 2/14/14	PG 2 OF 3	B-114-7-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. *(same as above)*	683.3	31																
	681.3	32																
VERY DENSE, GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP.		33	33 21 19	55	56	SS-13	-	58	17	8	10	7	18	14	4	8	A-1-b (0)	
	676.3	34																
MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST.		39	6 6 9	21	33	SS-14	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
-COBBLES PRESENT @ 40.0'	671.3	40																
HARD, BROWN TO GRAY **SILTY CLAY**, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		44	14 14 16	41	72	SS-15	4.50	4	1	3	46	46	31	15	16	20	A-6b (10)	
-INTRODUCED MUD @ 43.5'		49	11 11 11	30	83	SS-16	4.25	-	-	-	-	-	-	-	-	19	A-6b (V)	
	661.3	54	21 32 50/3"	-	100	SS-17	-	9	3	3	38	47	41	18	23	14	A-7-6 (13)	
HARD, GRAY **CLAY**, SOME TO "AND" SILT, TRACE TO LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, DAMP.																		
-ROCK FRAGMENTS PRESENT IN SS-17		59	31 50/5"	-	100	SS-18	-	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		61																

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 271+12.84 / 28.4 RT	START: 2/4/14	END: 2/14/14	PG 3 OF 3	B-114-7-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
HARD, GRAY **CLAY**, SOME TO "AND" SILT, TRACE TO LITTLE FINE GRAVEL, TRACE COARSE TO FINE SAND, DAMP. *(same as above)*	651.2	63																
		64	21 21 50/5"	-	59	SS-19	-	15	0	1	32	52	50	24	26	17	A-7-6 (16)	
	648.4	TR 65																
SHALE : GRAY, HIGHLY WEATHERED, VERY WEAK.		66																
		67																
		68																
		69	18 24 50/3"	-	67	SS-20	-	-	-	-	-	-	-	-	-	12	Rock (V)	
		70																
		71																
		72																
		73																
AUGER REFUSAL @ 74.0'	639.3	74																
LIMESTONE : DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THICK BEDDED, CALCAREOUS, DOLOMITIC, ARGILLACEOUS, CALCITE VEINS, CHERT INCLUSIONS, JOINTED, MODERATELY TO HIGHLY FRACTURED, OPEN APERATURES, ROUGH; RQD 50%, REC 87%. -QU @ 75.1' = 8,488 PSI		75	48		92	RC-1											CORE	
		76																
		77																
		78																
		79																
-QU @ 81.5' = 9,141 PSI		80	52		83	RC-2											CORE	
		81																
		82																
		83																
	629.3	EOB 84																

NOTES: SEEPAGE ENCOUNTERED @ 16.0'; GROUNDWATER ENCOUNTERED INITIALLY @ 17.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT 100 LBS BENTONITE 70 GALLONS WATER; COMPACTED WITH THE AUGER 300 LBS BENTONITE CHIPS AND SOIL CUTTINGS

B-114-7-13 – RC-1 and RC-2 – Depth from 74.0 to 84.0 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / J.K.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 273+13.25 / 16.5' LT	**EXPLORATION ID B-114-8-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-71 SB		
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 4/26/13	ELEVATION: 714.0 (MSL) EOB: 82.0 ft.		PAGE 1 OF 3
START: 3/11/14 END: 3/13/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 77.7	LAT / LONG: 39.953894, -83.005886		

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.3' - TOPSOIL (3.0")	713.7																	
FILL: VERY STIFF TO HARD, DARK BROWN **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.			7 8 8	21	50	SS-1	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
			6 7 9	21	61	SS-2	3.00	21	22	14	25	18	32	22	10	17	A-4a (2)	
	708.5																	
STIFF TO VERY STIFF, BROWN TO DARK BROWN **SILTY CLAY**, LITTLE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.			3 2 1	4	33	SS-3	1.75	-	-	-	-	-	-	-	-	24	A-6b (V)	
			5 5 8	17	50	SS-4	2.25	-	-	-	-	-	-	-	-	21	A-6b (V)	
			2 3 4	9	89	SS-5	1.25	1	2	12	36	49	38	16	22	22	A-6b (13)	
			4 4 4	10	72	SS-6	1.25	-	-	-	-	-	-	-	-	22	A-6b (V)	
	698.5																	
MEDIUM DENSE TO DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		W	14 16 10	34	72	SS-7	-	64	13	9	10	4	20	19	1	10	A-1-a (0)	
		W	8 7 8	19	83	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
	693.5																	
MEDIUM DENSE TO DENSE, DARK BROWN TO BROWN **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.			4 8 16	31	56	SS-9	-	35	42	9	10	4	NP	NP	NP	16	A-1-b (0)	
-COBBLES PRESENT THROUGHOUT			12 16 18	44	72	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
-INTRODUCED MUD @ 25.0'			5 3 8	14	33	SS-11	-	-	-	-	-	-	-	-	-	30	A-1-b (V)	
	686.0																	
VERY DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DRY TO MOIST.			19 27 28	71	72	SS-12	-	63	18	7	9	3	NP	NP	NP	12	A-1-a (0)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 273+13.25 / 16.5 LT	START: 3/11/14	END: 3/13/14	PG 2 OF 3	B-114-8-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DRY TO MOIST. *(same as above)* -COBBLES PRESENT THROUGHOUT	684.0	31–34	50/5"	-	20	SS-13	-	-	-	-	-	-	-	-	-	3	A-1-a (V)	
HARD, GRAY **SILTY CLAY**, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.	677.0	34–39	5 6 8	18	33	SS-14	4.25	3	2	2	38	55	36	18	18	21	A-6b (11)	
MEDIUM DENSE, GRAY **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, MOIST.	672.0	39–44	4 8 6	18	100	SS-15	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	
VERY STIFF TO HARD, BROWN **CLAY**, SOME SILT, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.	669.2	44–45					3.50	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
		45–49	8 10 13	30	67	SS-16	3.50	15	11	10	30	34	42	20	22	18	A-7-6 (11)	
		49–54	6 42 50/5"	-	65	SS-17	4.5+	-	-	-	-	-	-	-	-	12	A-7-6 (V)	
		54–59	10 49 50/3"	-	100	SS-18	4.5+	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		59–61																

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 273+13.25 / 16.5 LT	START: 3/11/14	END: 3/13/14	PG 3 OF 3	B-114-8-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 651.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	650.5	TR 63																
SHALE : GRAY, HIGHLY WEATHERED, VERY WEAK.		64	37 50/4"	-	100	SS-19	-	-	-	-	-	-	-	-	-	15	Rock (V)	
AUGER REFUSAL @ 67.0'	647.0	65 66 67																
SHALE : DARK GRAY, SLIGHTLY WEATHERED, VERY WEAK TO WEAK, THINLY LAMINATED TO LAMINATED, ARGILLACEOUS, FRACTURED TO HIGHLY FRACTURED, NARROW TO OPEN APERTURES, SLICKENSIDED TO SLIGHTLY ROUGH; RQD 19%, REC 82%. -0.5' CLAYSTONE SEAM @ 67.7' -CLAYSTONE SEAMS PRESENT FROM 69.5' TO 72.0'	642.0	68 69 70 71 72	19		82	RC-1											CORE	
CLAYSTONE : DARK GRAY, SLIGHTLY WEATHERED, VERY WEAK TO WEAK, THINLY LAMINATED BEDDING TO VERY THIN BEDDED, FRACTURED TO HIGHLY FRACTURED, OPEN APERTURES, ROUGH; RQD 12%, REC 97%. -QU @ 74.8' = 92 PSI	637.0	73 74 75 76 77	12		97	RC-2											CORE	
LIMESTONE : GRAY, UNWEATHERED, STRONG, VERY THICK BEDDED, CALCAREOUS, CHERTY, PYRITIC, JOINTED, SLIGHTLY FRACTURED TO FRACTURED, NARROW TO OPEN APERTURES, SLIGHTLY ROUGH; RQD 92%, REC 98%. -QU @ 78.4' = 12,567 PSI	632.0	EOB 78 79 80 81 82	92		98	RC-3											CORE	

NOTES: SEEPAGE ENCOUNTERED @ 16.0'; GROUNDWATER ENCOUNTERED INITIALLY @ 18.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT 50 LBS BENTONITE 40 GALLONS WATER AND SOIL CUTTINGS

B-114-8-13 – RC-1 and RC-2 – Depth from 67.0 to 77.0 feet

B-114-8-13 – RC-3 – Depth from 77.0 to 82.0 feet

DLZ Ohio, Inc. * 6121 Huntley Road, Columbus, Ohio 43229 * (614) 888-0040

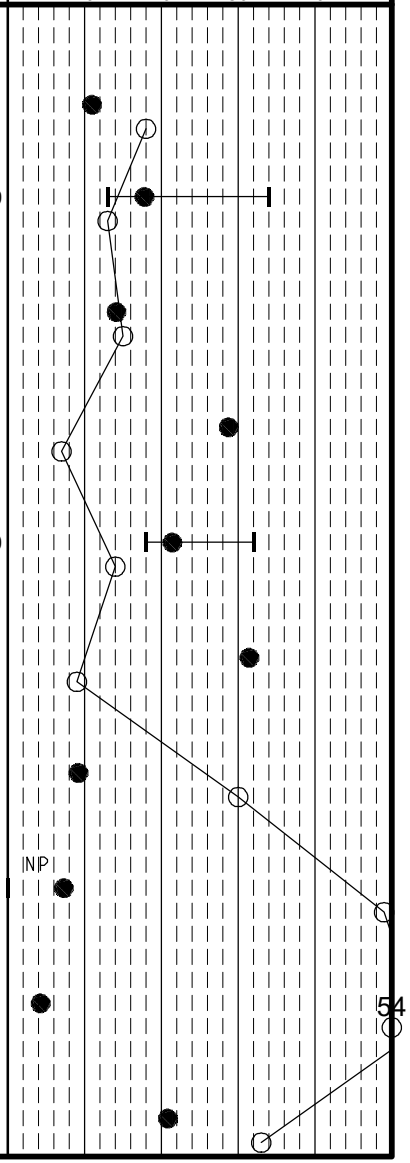
Client: ms consultants | *Project:* FRA-70-8.93 | *Job No.* 0221-1004.01

LOG OF: Boring B-115-0-09 | *Location:* Sta. 833+32.42, 17.8' RT., BL TRANS RAMP D3N | *Date Drilled:* 9/3/2009

WATER OBSERVATIONS:
Water seepage at: 21.0'
Water level at completion: 18.5'
FIELD NOTES:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	Graphic Log	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	711.2													
1.5	709.7						Asphalt Concrete - 5" Aggregate Base - 13"							
		5 10 8	6	1		1.5	FILL: Stiff to very stiff brown SILTY CLAY (A-6b), some fine to coarse sand, little gravel; damp.							
5		5 6 7	18	2		3.0			16	16	---	8	31	29
		12 10 5	18	3		1.5	@ 6.0'-7.5', contains brick and asphalt fragments.							
8.5	702.7													
		1 2 5	10	4		2.0	Very stiff dark brown to brown SILT AND CLAY (A-6a), little fine to coarse sand, trace gravel; damp.							
10							@ 8.5'-10.0', contains trace organic material.							
		5 6 8	18	5		2.75			0	1	---	13	46	40
13.5	697.7													
		2 2 7	18	6		1.5	Stiff brown SILTY CLAY (A-6b), little to some fine to coarse sand, little gravel; moist.							
15														
16.0	695.2													
		6 11 18		7			Dense to very dense brown GRAVEL WITH SAND (A-1-b), little to some silt; damp.							
		30 26 22	6	8					48	16	---	11	--25--	
20														
		47 38 15	1	9										
23.5	687.7													
		11 6 26	13	10		1.75	Stiff brown SANDY SILT (A-4a), trace gravel; moist. Bottom of Boring - 25.0'							
25.0	686.2													

STANDARD PENETRATION (N60)
Natural Moisture Content, % -
PL ⊢—⊣ *LL*
Blows per foot - ○ / *Non-Plastic -* NP
10 20 30 40



RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / T.F.	DRILL RIG: CME 750X (SN 310218)	STATION / OFFSET: 276+68.11 / 2.0' RT	**EXPLORATION ID B-115-1-13**	
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / C.D.	HAMMER: AUTOMATIC	ALIGNMENT: BL I-71 SB		
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/20/14	ELEVATION: 714.6 (MSL) EOB: 75.5 ft.		PAGE 1 OF 3
START: 1/13/15 END: 1/14/15	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 85.7	LAT / LONG: 39.953729, -83.004634		

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.8' - TOPSOIL (9.0")	713.8																	
FILL: VERY STIFF, DARK BROWN **SANDY SILT**, SOME CLAY, LITTLE FINE GRAVEL, DAMP. -ORGANICS PRESENT IN SS-1 -BRICK AND ROCK FRAGMENTS PRESENT IN SS-2	709.1	1 2 3 4 5	2 7 6	19	61	SS-1	4.00	-	-	-	-	-	-	-	-	19	A-4a (V)	
			3 4 5	13	67	SS-2	3.50	13	14	10	42	21	32	22	10	21	A-4a (6)	
FILL: HARD, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP. -ROCK FRAGMENTS PRESENT THROUGHOUT	704.1	6 7 8 9 10	4 6 7	19	50	SS-3	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	
			6 5 6	16	61	SS-4	4.5+	14	10	15	33	28	33	22	11	16	A-6a (6)	
FILL: LOOSE TO MEDIUM DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP.	699.1	11 12 13 14 15	5 5 5	14	61	SS-5	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	
			2 3 3	9	56	SS-6	-	73	12	5	7	3	NP	NP	NP	2	A-1-a (0)	
FILL: STIFF TO VERY STIFF, BROWN **SANDY SILT**, LITTLE FINE GRAVEL, LITTLE CLAY, DAMP. -IRON STAINING PRESENT IN SS-8	695.6	16 17 18 19 20	2 4 4	11	78	SS-7	2.00	14	13	31	29	13	25	18	7	13	A-4a (1)	
			11 14 13	39	83	SS-8	4.00	-	-	-	-	-	-	-	-	15	A-4a (V)	
							-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
MEDIUM DENSE TO VERY DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT THROUGHOUT -COBBLES PRESENT @ 26.0'	686.6	21 22 23 24 25 W	3 7 4	16	33	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-a (V)	
			4 10 11	30	78	SS-10	-	64	11	15	7	3	NP	NP	NP	9	A-1-a (0)	
		26 27 28	10 49 49	140	50	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
DENSE TO VERY DENSE, BROWN TO DARK GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.		29 W	11 10 11	30	100	SS-12	-	58	5	28	5	4	23	18	5	16	A-1-b (0)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 276+68.11 / 2.0 RT	START: 1/13/15	END: 1/14/15	PG 2 OF 3	B-115-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
DENSE TO VERY DENSE, BROWN TO DARK GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST. *(same as above)*	684.6	31																
-ROCK FRAGMENTS PRESENT THROUGHOUT		32																
		33																
		34	7 24 27	73	78	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		35																
	677.6	36																
VERY STIFF, GRAY **SANDY SILT**, SOME CLAY, TRACE FINE GRAVEL, DAMP.		37																
		38																
		39	15 16 28	63	78	SS-14	4.00	2	6	12	47	33	26	16	10	15	A-4a (8)	
		40																
		41																
		42																
		43																
-ROCK FRAGMENTS PRESENT IN SS-15		44	18 32 48	114	89	SS-15	3.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
	667.6	45																
VERY DENSE, GRAY **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST.		46																
		47																
		48																
		49	6 35 44	113	78	SS-16	-	-	-	-	-	-	-	-	-	10	A-2-6 (V)	
		50																
	662.6	51																
VERY DENSE, GRAY **GRAVEL**, TRACE COARSE TO FINE SAND, TRACE SILT, MOIST.		52																
		53																
		54	12 36 50/5"	-	71	SS-17	-	89	1	9	1	0	NP	NP	NP	8	A-1-a (0)	
		55																
		56																
		57																
		58																
		59	36 44 28	103	44	SS-18	-	-	-	-	-	-	-	-	-	16	A-1-a (V)	
		60																
		61																

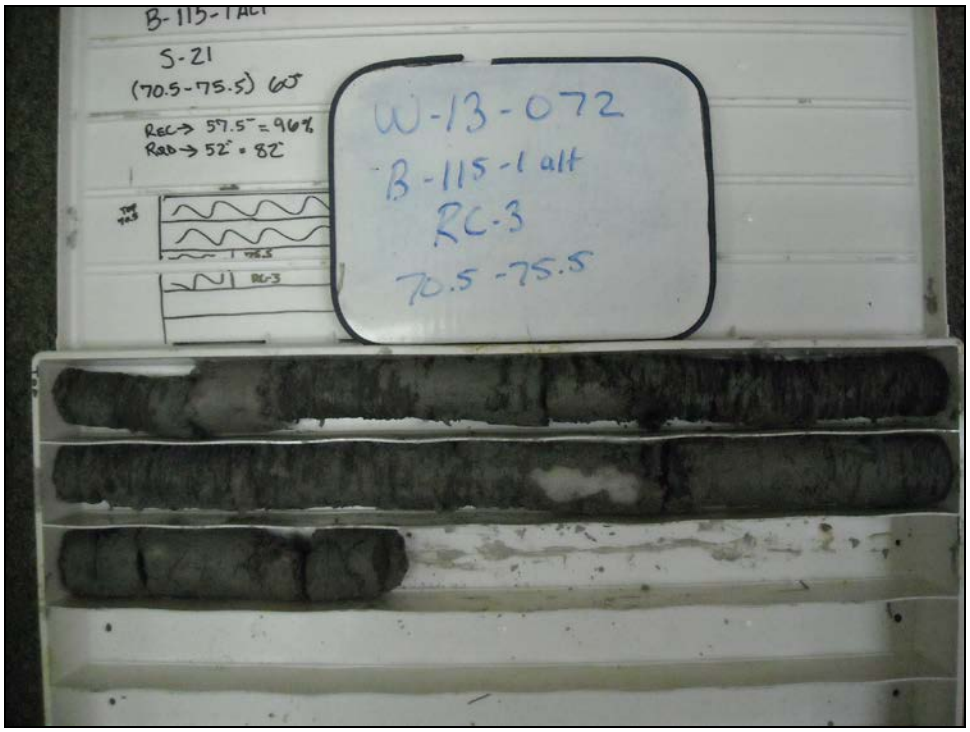
PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 276+68.11 / 2.0 RT	START: 1/13/15	END: 1/14/15	PG 3 OF 3	B-115-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 652.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY DENSE, GRAY **GRAVEL**, TRACE COARSE TO FINE SAND, TRACE SILT, MOIST. *(same as above)*	651.1	TR 63																
MUDSTONE : GRAY, HIGHLY WEATHERED TO UNWEATHERED, VERY WEAK TO WEAK, LAMINATED TO THICK BEDDED, FRIABLE, FISSILE, CALCAREOUS, SLIGHTLY TO HIGHLY WEATHERED, MODERATELY TO HIGHLY FRACTURED, THIGHT APERTURES, SLIGHTLY TO VERY ROUGH; RQD 69%, REC 97%.		64 65	100		100	RC-1											CORE	
-0.3' LIMESTONE SEAM @ 68.5'		66 67 68	40		95	RC-2											CORE	
-0.3' LIMESTONE SEAM @ 70.1"		69 70 71																
-0.3' LIMESTONE SEAM @ 73.5'		72 73 74	87		96	RC-3											CORE	
	639.1	EOB 75																

NOTES: SEEPAGE ENCOUNTERED @ 24.0'; GROUNDWATER INITIALLY ENCOUNTERED @ 29.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-115-1-13 – RC-1 and RC-2 – Depth from 63.5 to 70.5 feet



B-115-1-13 – RC-3 – Depth from 70.5 to 75.5 feet

APPENDIX IV

LABORATORY TEST RESULTS

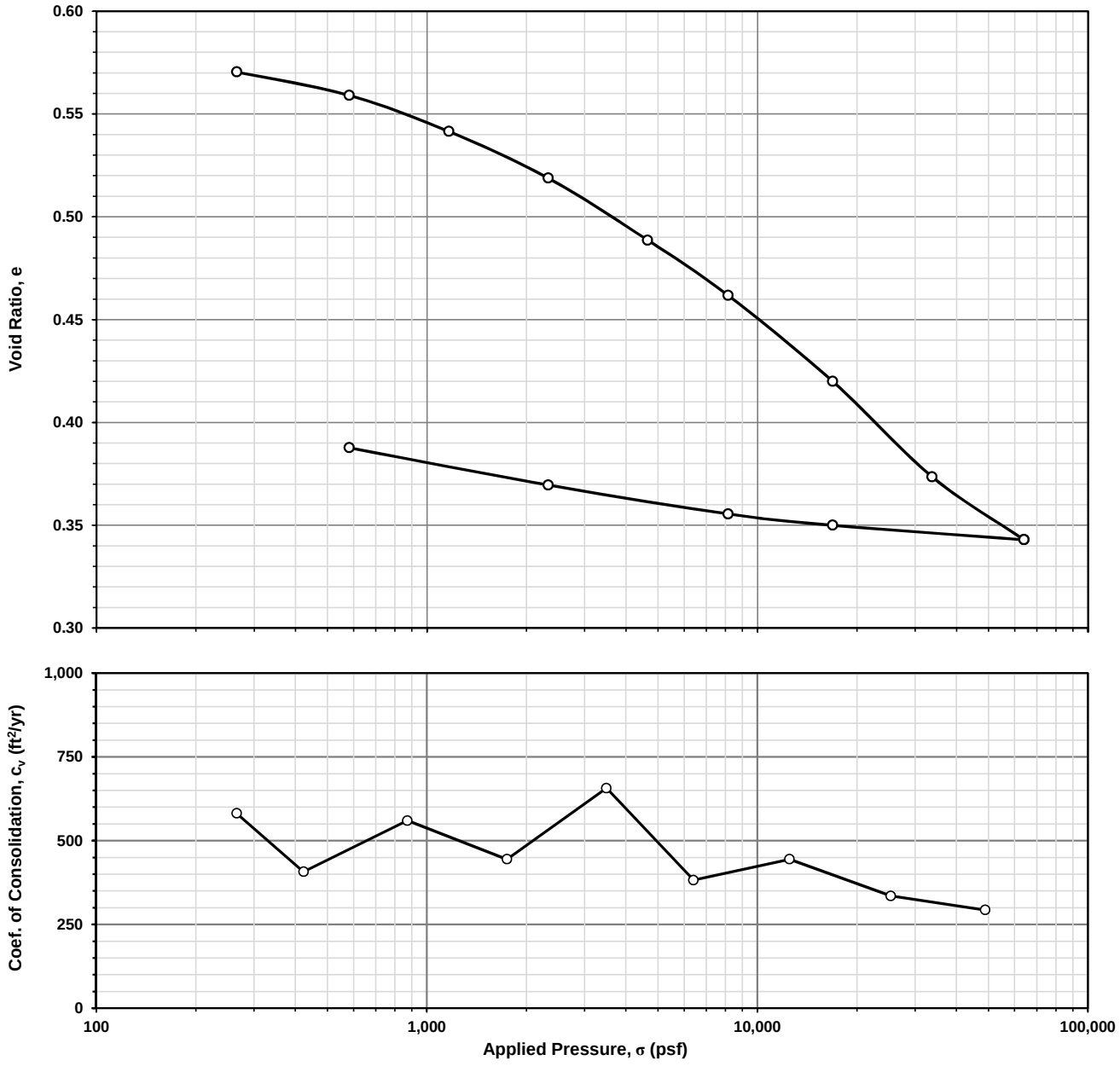
One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number:	W-13-045	Boring Number:	B-020-2-13
Project Name:	FRA-70-12.68	Station / Offset:	176+13.62, 34.0' Rt.
Project Location:	Columbus, Ohio	Sample No. / Depth:	ST-6 / 14.7 ft
Client:	GPD GROUP	Date of Testing:	08/13/2013 to 08/30/2013

Soil Description: Brown CLAY, and coarse to fine sand, some silt, little fine gravel.
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	41	16	25	17	31	13	24	15

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' (psf)	c_c	c_r
S_o	w_o								
101.6%	19.9%	105.6	128.9	1,617	2.67	0.578	2,470	0.154	0.022



One-Dimensional Consolidation Test Report (ASTM D2435)

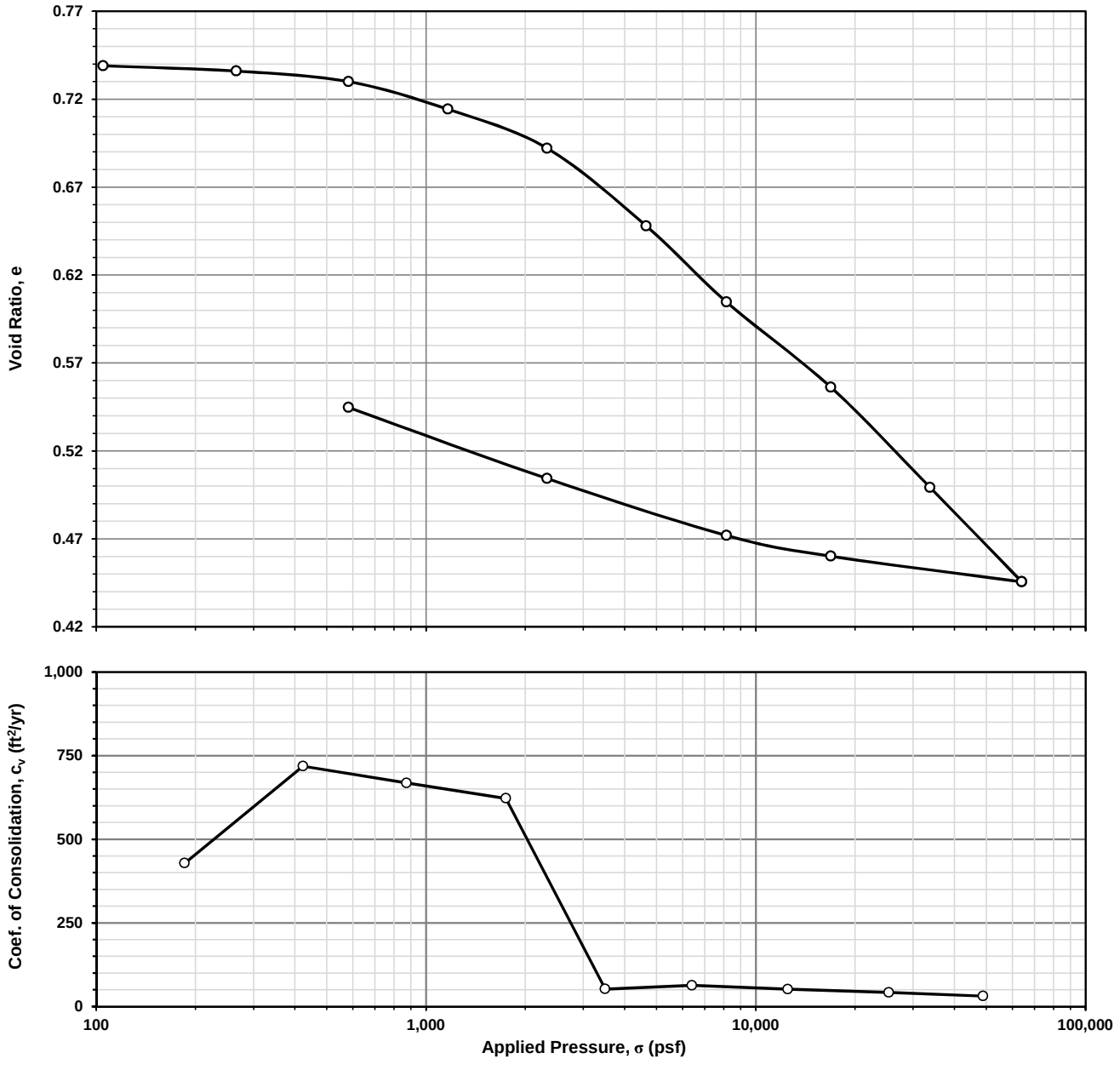
Project Number:	W-13-072	Boring Number:	B-020-7-13
Project Name:	FRA-70-13.10	Station / Offset:	176+68.64, 1.8' Rt.
Project Location:	Columbus, Ohio	Sample No. / Depth:	ST-4 / 11.8 ft
Client:	ms consultants, inc.	Date of Testing:	01/27/2015 to 02/12/2015

Soil Description: Dark brown CLAY, "and" silt, trace coarse to fine sand

Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	43	19	24	0	2	7	45	46

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' (psf)	c_c	c_r
S_o	w_o								
99.6%	23.3%	95.5	122.0	1,357	2.67	0.745	3,449	0.210	0.049



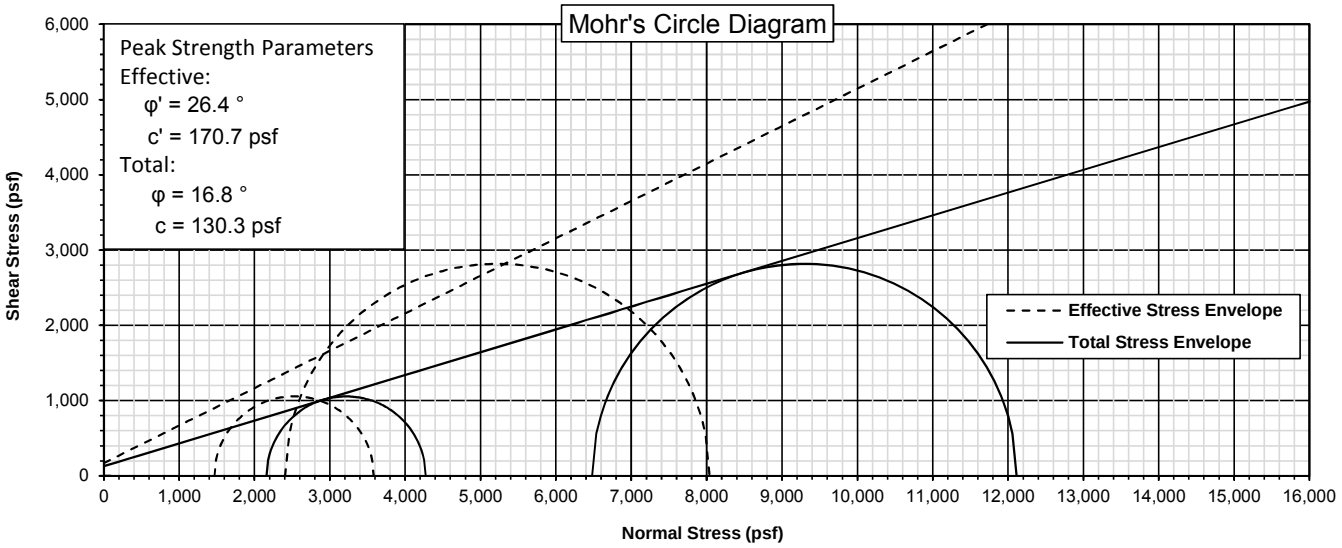
Consolidated, Undrained Triaxial Compression Test Report (ASTM D4767)

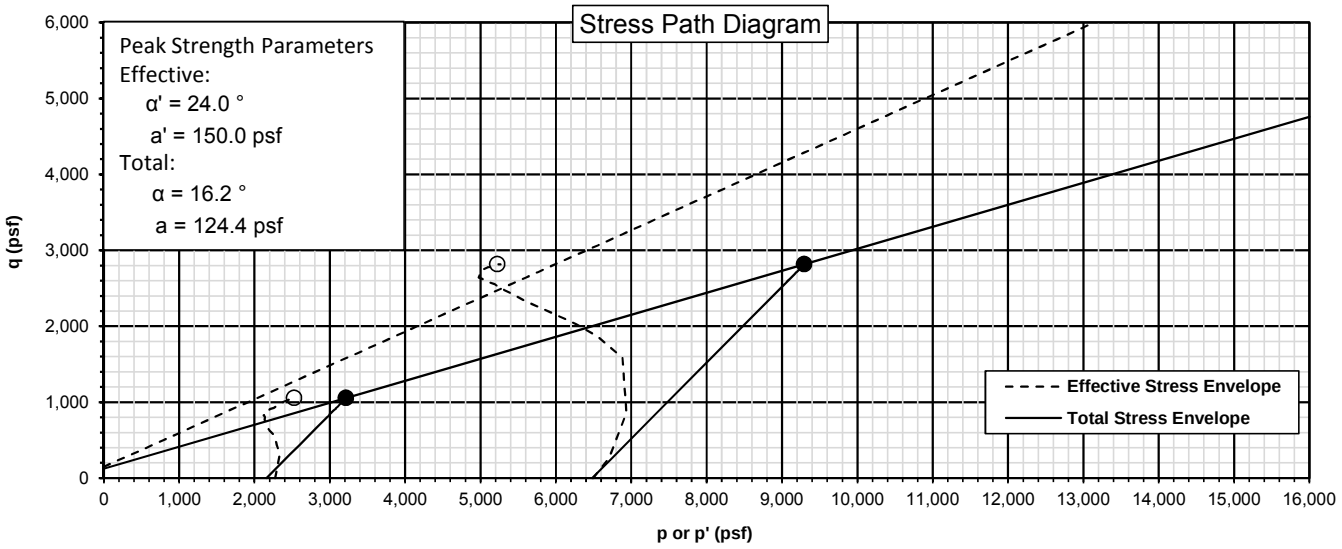
Project Number:	W-13-045	Boring Number:	B-020-2-13
Project Name:	FRA-70-12.68	Station / Offset:	176+13.92, 34.0' Rt.
Project Location:	Columbus, Ohio	Sample No. / Depth:	ST-6 / 13.5 ft to 14.0 ft
Client:	GPD GROUP	Date of Testing:	08/14/2013 to 08/21/2013

Soil Description: Brown CLAY, "and" coarse to fine sand, some silt, little fine gravel.
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	41	16	25	17	31	13	24	15

Stage	Boring No.	Sample No.	Depth (ft)	$(\sigma_3)_f$ (psf)	$(\sigma_1)_f$ (psf)	$(\sigma_3')_f$ (psf)	$(\sigma_1')_f$ (psf)	p'_f (psf)	q_f (psf)
1	B-020-2-13	ST-6	13.5	2,160.0	4,271.8	1,468.8	3,580.6	2,524.7	1,055.9
2	B-020-2-13	ST-6	14	6,480.0	12,114.6	2,404.8	8,039.4	5,222.1	2,817.3
3									





Notes:

Consolidated, Undrained Triaxial Compression Test (ASTM D4767)

Project Number:	W-13-045	Boring Number:	B-020-2-13
Project Name:	FRA-70-12.68	Station / Offset:	176+13.92, 34.0' Rt.
Project Location:	Columbus, Ohio	Sample No. / Depth:	ST-6 / 13.5 ft
Client:	GPD GROUP	Date of Testing:	6/21/2013

Data for Specimen No. 1

Soil Description: Brown CLAY, "and" coarse to fine sand, some silt, little fine gravel.
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	41	16	25	17	31	13	24	15

Diameter, D_0	2.854	in	Volume of Solids , V_s :	21.813	in^3
Area, A_0	6.396	in^2	Initial Volume of Voids, V_v :	14.805	in^3
Height, L_0	5.725	in	Initial Void Ratio, e_o :	0.679	
Volume, V_0	36.618	in^3	Initial Degree of Saturation, S_0 :	88.2	%

Water Content BEFORE Test

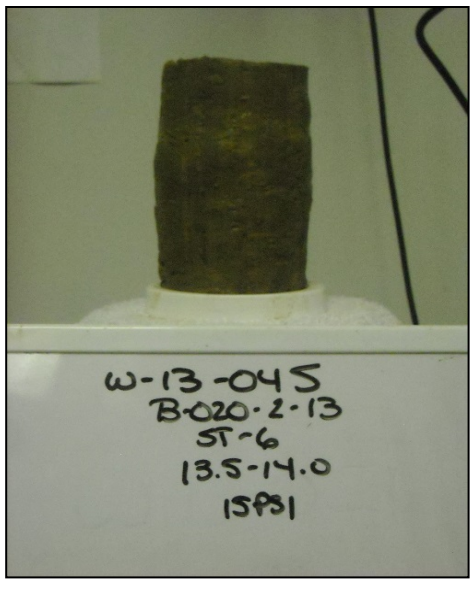
Tin No.:	M-74	g
Wet Soil + Tin :	146.25	g
Dry Soil + Tin :	124.58	g
Tin Weight :	27.9	g
Dry Mass :	96.68	g
Weight of water :	21.67	g
Moisture :	22.41	%

Water Content AFTER Test (Total Specimen)

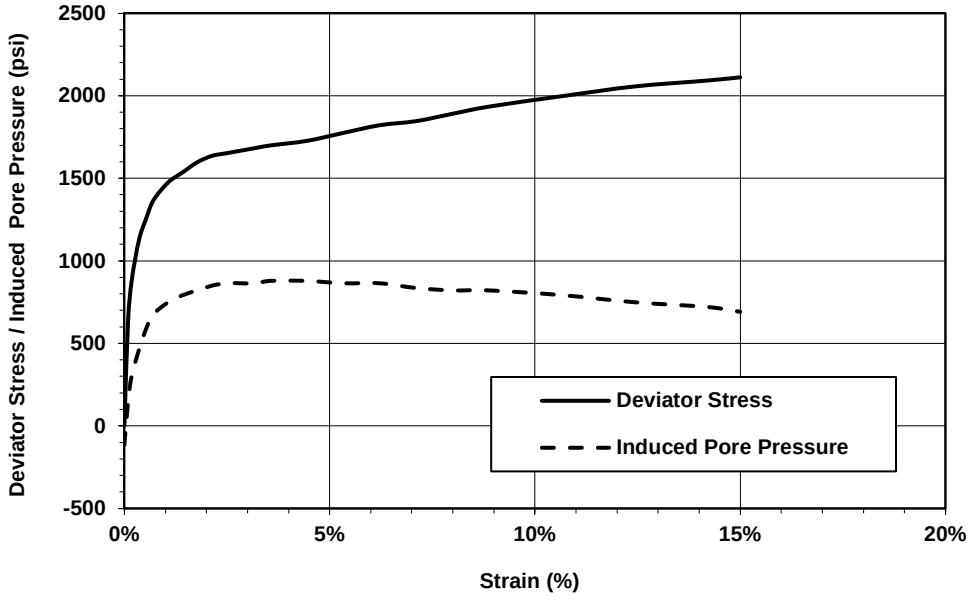
Tin No.:	KDW	g
Wet Soil + Tin :	1262.80	g
Dry Soil + Tin :	1032.30	g
Tin Weight :	77.90	g
Dry Mass :	954.40	g
Weight of water :	230.50	g
Moisture :	24.15	%
Wet Density :	123.27	pcf
Dry Density :	99.29	pcf

Consolidation Cell Pressure:	140.0	psi	Deviator Stress @ Failure, Ds:	2,112	psf
Consolidation Back Pressure:	125.0	psi	Axial Strain @ Failure:	15.0	%
Effective Confining Stress, σ_3:	15.0	psi	Major Principal Stress @ Failure, σ_1:	4,272	psf
	2,160	psf	Induced Pore Pressure @ Failure:	691	psf
Strain Rate:	0.0030	in/min	Effective Minor Principal Stress,σ'_3:	1,469	psf
			Effective Major Principal Stress, σ'_1:	3,581	psf

Failure Sketch



CU Compressive Strength and Induced Pore Pressure



Notes:

Consolidated, Undrained Triaxial Compression Test (ASTM D4767)

Project Number:	W-13-045	Boring Number:	B-020-2-13
Project Name:	FRA-70-12.68	Station / Offset:	176+13.92, 34.0' Rt.
Project Location:	Columbus, Ohio	Sample No. / Depth:	ST-6 / 14.0 ft
Client:	GPD GROUP	Date of Testing:	8/21/2013

Data for Specimen No. 2

Soil Description: Brown CLAY, "and" coarse to fine sand, some silt, little fine gravel.
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	41	16	25	17	31	13	24	15

Diameter, D_0	2.849	in	Volume of Solids , V_s :	23.322	in^3
Area, A_0	6.376	in^2	Initial Volume of Voids, V_v :	13.698	in^3
Height, L_0	5.806	in	Initial Void Ratio, e_o :	0.587	
Volume, V_0	37.019	in^3	Initial Degree of Saturation, S_0 :	101.89	%

Water Content BEFORE Test

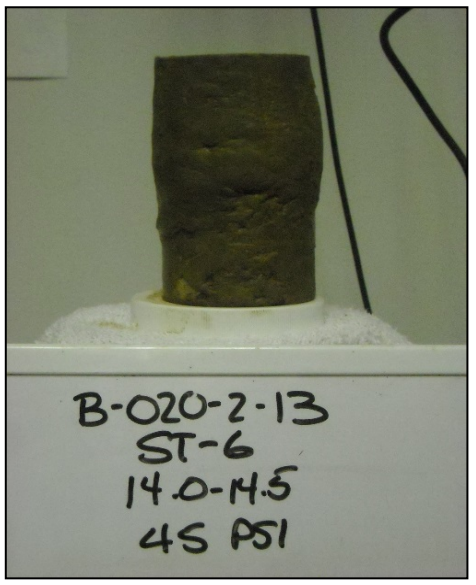
Tin No.:	M-74	g
Wet Soil + Tin :	146.25	g
Dry Soil + Tin :	124.58	g
Tin Weight :	27.9	g
Dry Mass :	96.68	g
Weight of water :	21.67	g
Moisture :	22.41	%

Water Content AFTER Test (Total Specimen)

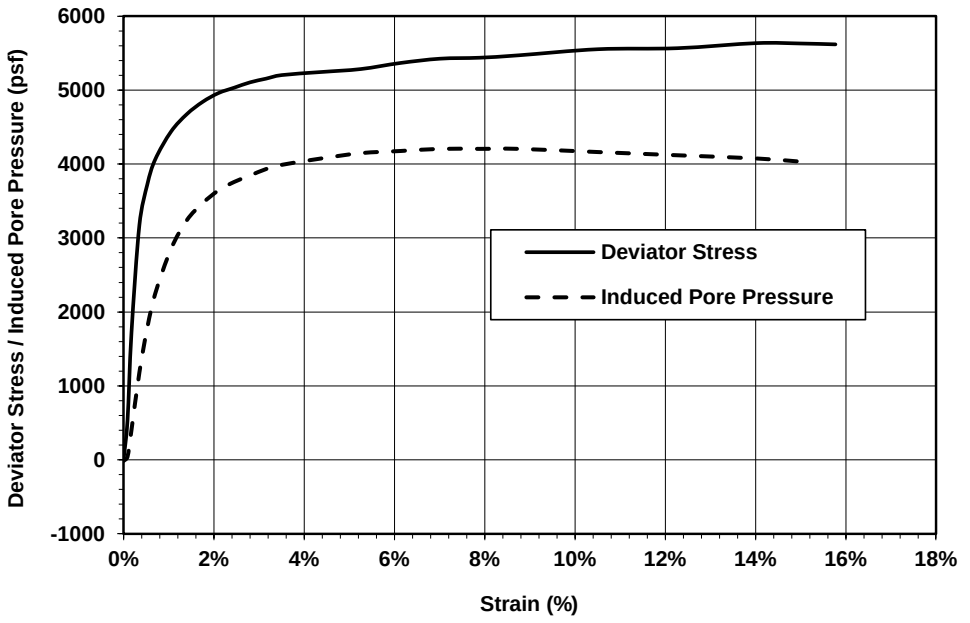
Tin No.:	BC	g
Wet Soil + Tin :	1307.40	g
Dry Soil + Tin :	1110.10	g
Tin Weight :	89.70	g
Dry Mass :	1020.40	g
Weight of water :	197.30	g
Moisture :	19.34	%
Wet Density :	125.31	pcf
Dry Density :	105.01	pcf

Consolidation Cell Pressure:	133.0	psi	Deviator Stress @ Failure, Ds:	5,635	psf
Consolidation Back Pressure:	88.0	psi	Axial Strain @ Failure:	14.0	%
Effective Confining Stress, σ_3:	45.0	psi	Major Principal Stress @ Failure, σ_1:	12,115	psf
	6,480	psf	Induced Pore Pressure @ Failure:	4,075	psf
Strain Rate:	0.0030	in/min	Effective Minor Principal Stress,σ'_3:	2,405	psf
			Effective Major Principal Stress, σ'_1:	8,039	psf

Failure Sketch



CU Compressive Strength and Induced Pore Pressure



Notes:

Consolidated, Undrained Triaxial Compression Test Report (ASTM D4767)

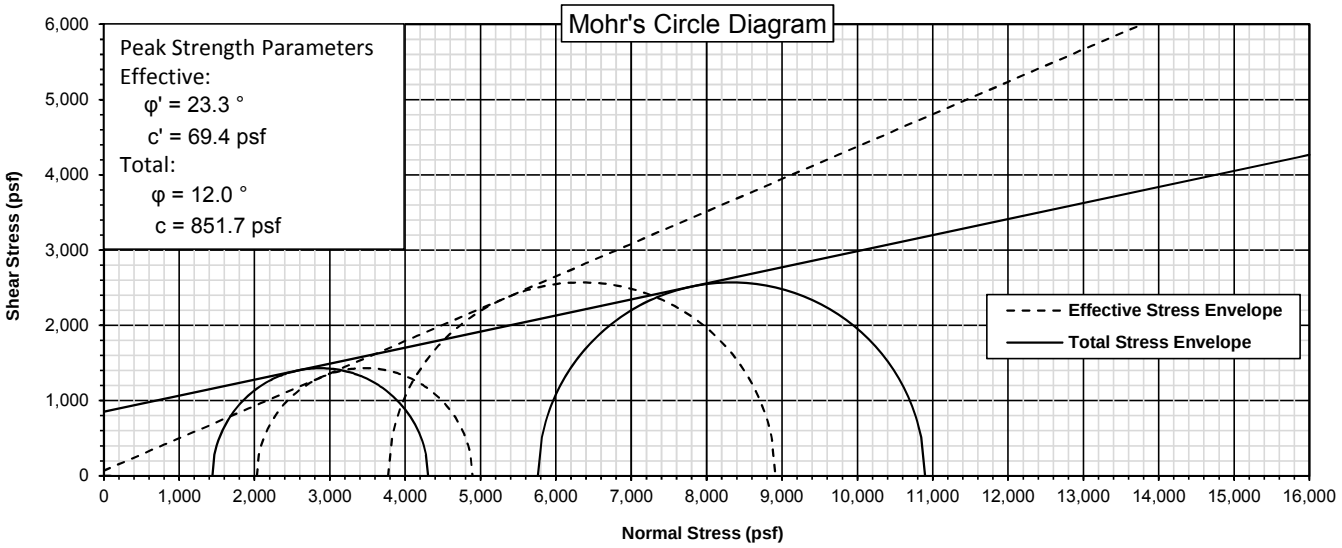
Project Number:	W-13-072	Boring Number:	B-020-7-13
Project Name:	FRA-70-13.10	Station / Offset:	176+68.64, 1.8' Rt.
Project Location:	Franklin County, Ohio	Sample No. / Depth:	ST-4 / 12.0 ft to 13.0 ft
Client:	ms consultants	Date of Testing:	01/28/2015 to 02/10/2015

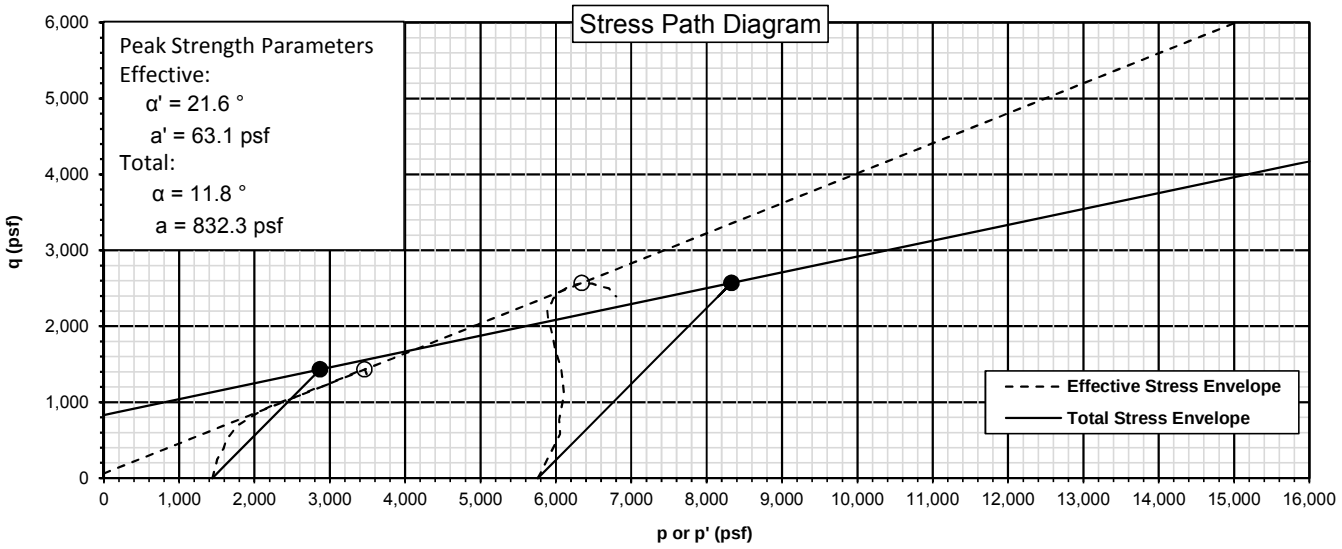
Soil Description: Dark brown CLAY, "and" silt, trace coarse to fine sand

Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	43	19	24	0	2	7	45	46

Stage	Boring No.	Sample No.	Depth (ft)	$(\sigma_3)_f$ (psf)	$(\sigma_1)_f$ (psf)	$(\sigma_3')_f$ (psf)	$(\sigma_1')_f$ (psf)	p'_f (psf)	q_f (psf)
1	B-020-7-13	ST-4	12.0-12.5	1,440.0	4,302.7	2,030.4	4,893.1	3,461.8	1,431.4
2	B-020-7-13	ST-4	12.5-13.0	5,760.0	10,900.3	3,772.8	8,913.1	6,343.0	2,570.2
3									





Notes:

Consolidated, Undrained Triaxial Compression Test (ASTM D4767)

Project Number:	W-13-072	Boring Number:	B-020-7-13
Project Name:	FRA-70-13.10	Station / Offset:	176+68.64, 1.8' Rt.
Project Location:	Franklin County, Ohio	Sample No. / Depth:	ST-4 / 12.0-12.5 ft
Client:	ms consultants	Date of Testing:	2/10/2015

Data for Specimen No. 1

Soil Description: Dark brown CLAY, "and" silt, trace coarse to fine sand
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	43	19	24	0	2	7	45	46

Diameter, D_0	2.872	in	Volume of Solids , V_s :	23.242	in^3
Area, A_0	6.478	in^2	Initial Volume of Voids, V_v :	15.246	in^3
Height, L_0	5.941	in	Initial Void Ratio, e_o :	0.656	
Volume, V_0	38.487	in^3	Initial Degree of Saturation, S_0 :	94.7	%

Water Content BEFORE Test

Tin No.:	X-16	g
Wet Soil + Tin :	113.18	g
Dry Soil + Tin :	97.47	g
Tin Weight :	29.97	g
Dry Mass :	67.5	g
Weight of water :	15.71	g
Moisture :	23.27	%

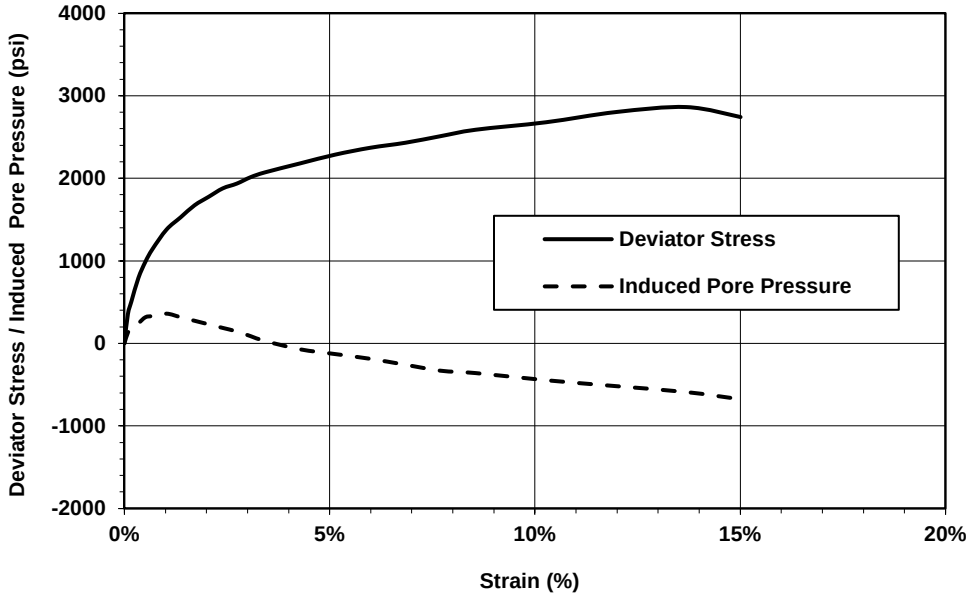
Water Content AFTER Test (Total Specimen)

Tin No.:	FUNKY	g
Wet Soil + Tin :	1316.50	g
Dry Soil + Tin :	1073.70	g
Tin Weight :	56.80	g
Dry Mass :	1016.90	g
Weight of water :	242.80	g
Moisture :	23.88	%
Wet Density :	124.69	pcf
Dry Density :	100.65	pcf

Consolidation Cell Pressure:	140.0	psi	Deviator Stress @ Failure, Ds:	2,863	psf
Consolidation Back Pressure:	130.0	psi	Axial Strain @ Failure:	13.7	%
Effective Confining Stress, σ_3:	10.0	psi	Major Principal Stress @ Failure, σ_1:	4,303	psf
	1,440	psf	Induced Pore Pressure @ Failure:	-590	psf
Strain Rate:	0.0030	in/min	Effective Minor Principal Stress,σ'_3:	2,030	psf
			Effective Major Principal Stress, σ'_1:	4,893	psf

Failure Sketch

CU Compressive Strength and Induced Pore Pressure



Notes:

Consolidated, Undrained Triaxial Compression Test (ASTM D4767)

Project Number:	W-13-072	Boring Number:	B-020-7-13
Project Name:	FRA-70-13.10	Station / Offset:	176+68.64, 1.8' Rt.
Project Location:	Franklin County, Ohio	Sample No. / Depth:	ST-4 / 12.5-13.0 ft
Client:	ms consultants	Date of Testing:	10/11/2014

Data for Specimen No. 2

Soil Description: Dark brown CLAY, "and" silt, trace coarse to fine sand
Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	43	19	24	0	2	7	45	46

Diameter, D_0	2.875	in	Volume of Solids , V_s :	23.795	in^3
Area, A_0	6.492	in^2	Initial Volume of Voids, V_v :	14.946	in^3
Height, L_0	5.968	in	Initial Void Ratio, e_o :	0.628	
Volume, V_0	38.741	in^3	Initial Degree of Saturation, S_0 :	98.93	%

Water Content BEFORE Test

Tin No.:	X-16	g
Wet Soil + Tin :	113.18	g
Dry Soil + Tin :	97.47	g
Tin Weight :	29.97	g
Dry Mass :	67.5	g
Weight of water :	15.71	g
Moisture :	23.27	%

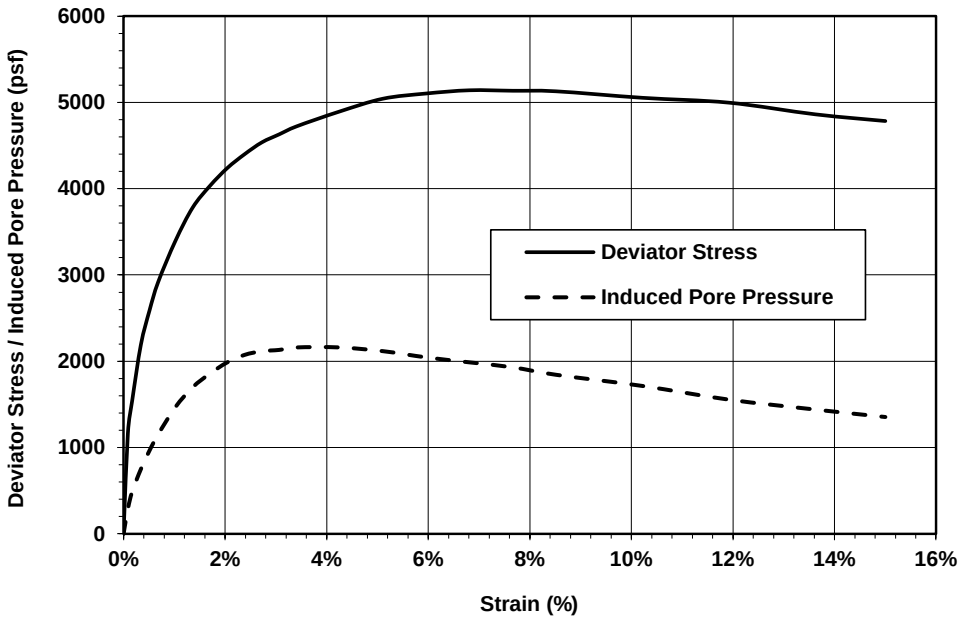
Water Content AFTER Test (Total Specimen)

Tin No.:	FUNKY	g
Wet Soil + Tin :	1325.30	g
Dry Soil + Tin :	1097.20	g
Tin Weight :	56.10	g
Dry Mass :	1041.10	g
Weight of water :	228.10	g
Moisture :	21.91	%
Wet Density :	124.80	pcf
Dry Density :	102.37	pcf

Consolidation Cell Pressure:	143.0	psi	Deviator Stress @ Failure, Ds:	5,140	psf
Consolidation Back Pressure:	103.0	psi	Axial Strain @ Failure:	6.8	%
Effective Confining Stress, σ_3:	40.0	psi	Major Principal Stress @ Failure, σ_1:	10,900	psf
	5,760	psf	Induced Pore Pressure @ Failure:	1,987	psf
Strain Rate:	0.0030	in/min	Effective Minor Principal Stress,σ'_3:	3,773	psf
			Effective Major Principal Stress, σ'_1:	8,913	psf

Failure Sketch

CU Compressive Strength and Induced Pore Pressure



Notes:

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

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Phone (614) 823-4949

9885 Rockside Road
Cleveland, OH 44125
Phone (216) 573-0955

4480 Lake Forest Drive
Cincinnati, Ohio 45242
Phone (513) 769-6998

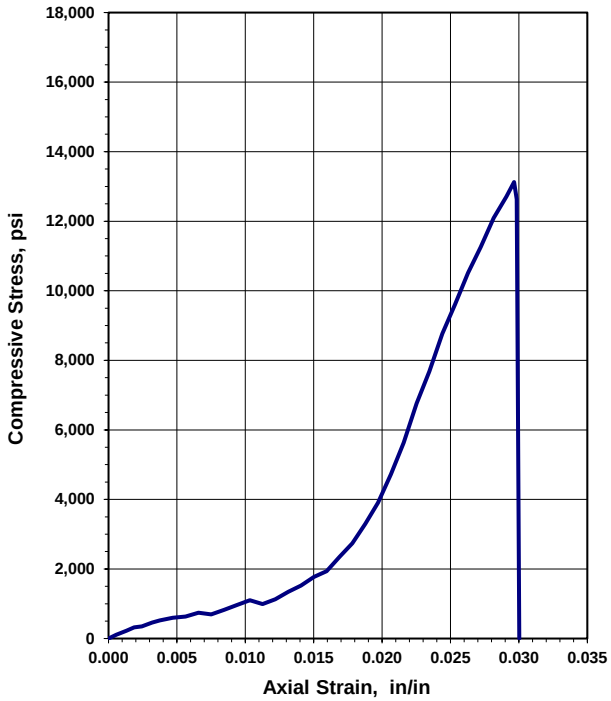
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 4/1/2014
Test Performed by: K.R./T.K.

Rock Description: Limestone

Boring No.:	B-20-4	Average Length:	5.329 in
Sample No:	RC-3	Average Diameter:	2.477 in
Depth (ft):	86.5	Length to diameter ratio:	2.151
Moisture condition:	As received	Cross Sectional Area:	4.816 in^2
Rate of Loading:	114.2 lbs/sec	Failure Load:	63,240 lbs
Testing Time:	554 sec	Axial Strain at Failure:	0.0296 in/in
	(Rate 2-15 minutes to failure)	Stress:	13,126 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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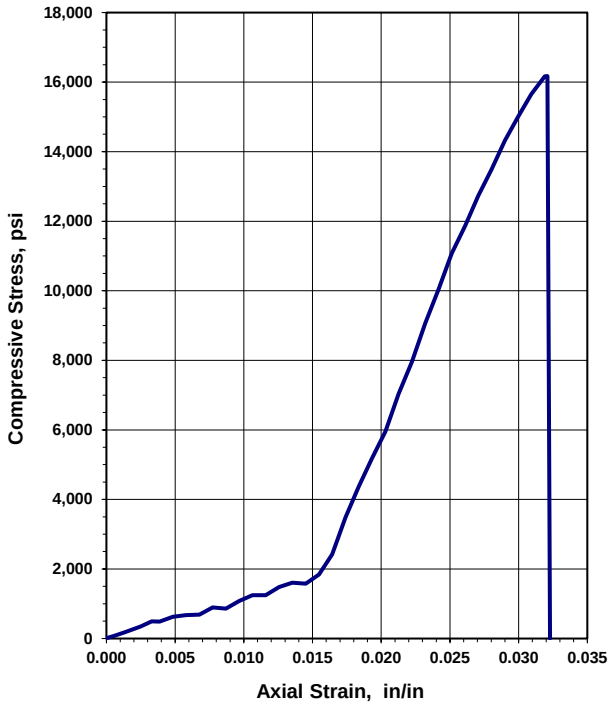
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 4/1/2014
Test Performed by: K.R./T.K.

Rock Description: Limestone

Boring No.:	B-20-4	Average Length:	5.173 in
Sample No:	RC-4	Average Diameter:	2.47 in
Depth (ft):	90.7	Length to diameter ratio:	2.094
Moisture condition:	As received	Cross Sectional Area:	4.789 in^2
Rate of Loading:	124.0 lbs/sec	Failure Load:	77,480 lbs
Testing Time:	625 sec	Axial Strain at Failure:	0.0321 in/in
	(Rate 2-15 minutes to failure)	Stress:	16,173 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

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Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 1/19/2015
Test Performed by: C.S./T.K.

Rock Description: Shale

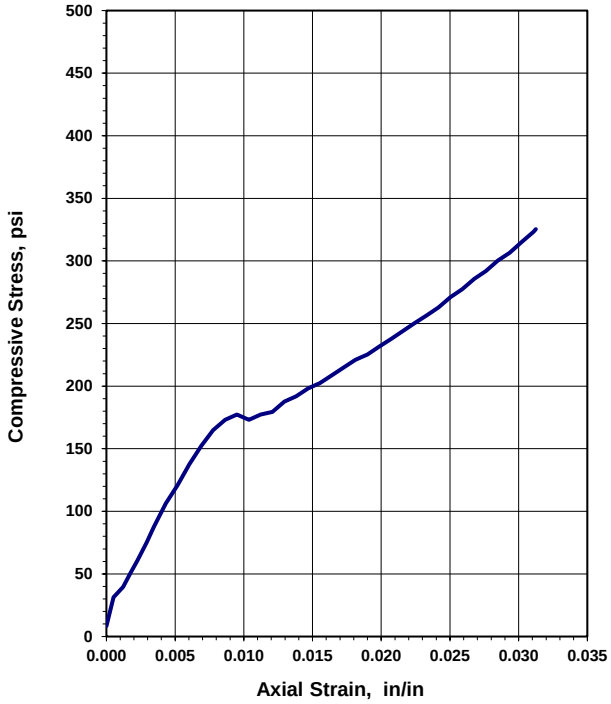
Boring No.: B-20-6
Sample No: RC-4
Depth (ft): 77.4
Moisture condition: As received

Average Length: 5.792 in
Average Diameter: 2.471 in
Length to diameter ratio: 2.344
Cross Sectional Area: 4.793 in^2

Rate of Loading: 2.1 lbs/sec
Testing Time: 413 sec
(Rate 2-15 minutes to failure)

Failure Load: 850 lbs
Axial Strain at Failure: 0.0095 in/in
Stress: 177 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Phone (513) 769-6998

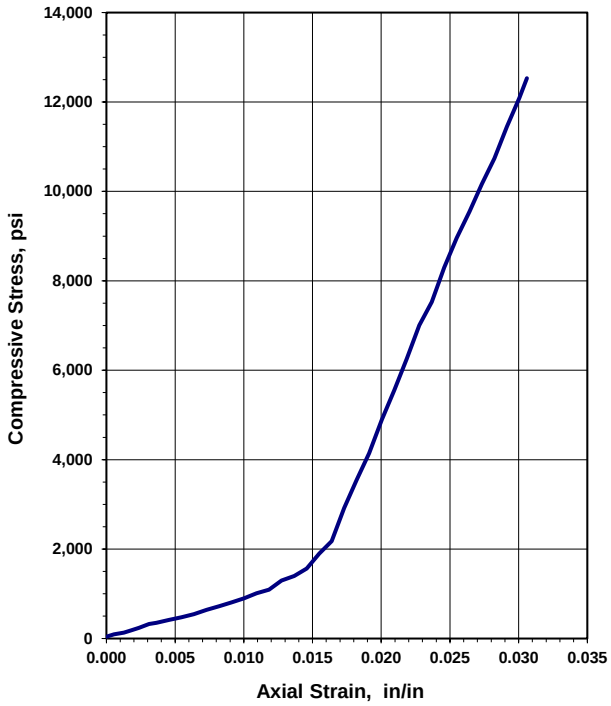
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 1/19/2015
Test Performed by: C.S./T.K.

Rock Description: Limestone with Chert nodules

Boring No.:	B-20-6	Average Length:	5.49 in
Sample No:	RC-7	Average Diameter:	2.488 in
Depth (ft):	91.5	Length to diameter ratio:	2.207
Moisture condition:	As received	Cross Sectional Area:	4.859 in^2
Rate of Loading:	82.5 lbs/sec	Failure Load:	60,910 lbs
Testing Time:	738 sec	Axial Strain at Failure:	0.0306 in/in
	(Rate 2-15 minutes to failure)	Stress:	12,531 psi

Unconfined Compression Test



Before Testing

After Failure

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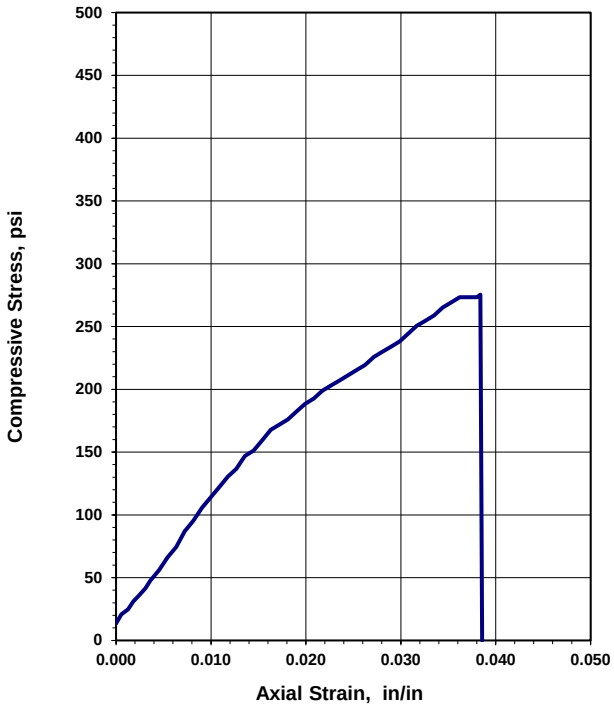
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 12/30/2014
Test Performed by: K.R./T.K.

Rock Description: Shale

Boring No.:	B-20-8	Average Length:	5.523 in
Sample No:	RC-2	Average Diameter:	2.48 in
Depth (ft):	71.2	Length to diameter ratio:	2.227
Moisture condition:	As received	Cross Sectional Area:	4.828 in^2
Rate of Loading:	2.9 lbs/sec	Failure Load:	1,330 lbs
Testing Time:	454 sec	Axial Strain at Failure:	0.0384 in/in
	(Rate 2-15 minutes to failure)	Stress:	275 psi

Unconfined Compression Test



Before Testing

After Failure

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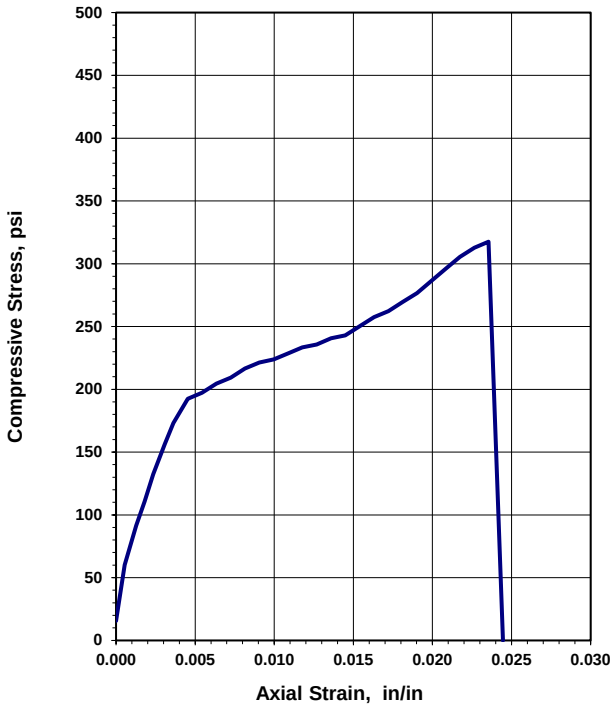
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 12/30/2014
Test Performed by: K.R./T.K.

Rock Description: Shale

Boring No.:	B-20-8	Average Length:	5.52 in
Sample No:	RC-5	Average Diameter:	2.301 in
Depth (ft):	85.9	Length to diameter ratio:	2.399
Moisture condition:	As received	Cross Sectional Area:	4.156 in^2
Rate of Loading:	4.1 lbs/sec	Failure Load:	1,320 lbs
Testing Time:	322 sec	Axial Strain at Failure:	0.0236 in/in
	(Rate 2-15 minutes to failure)	Stress:	318 psi

Unconfined Compression Test



Before Testing

After Failure

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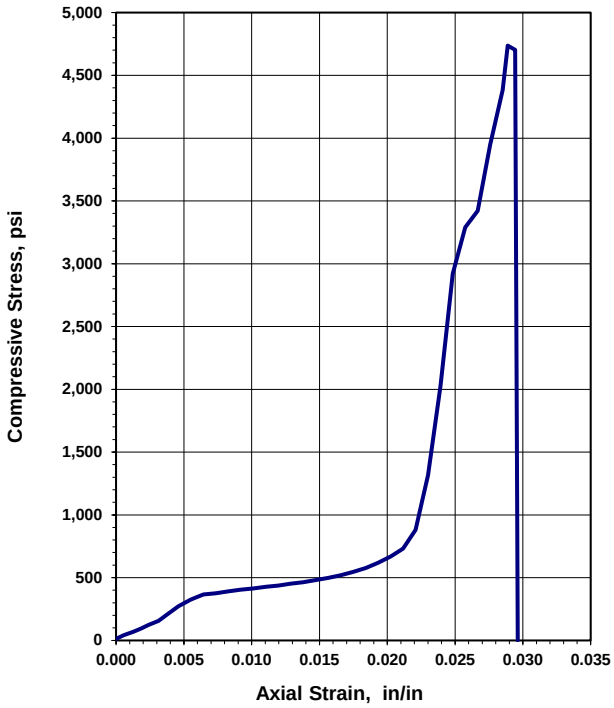
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 12/30/2014
Test Performed by: K.R./T.K.

Rock Description: Limestone

Boring No.:	B-20-8	Average Length:	5.435 in
Sample No:	RC-8	Average Diameter:	2.491 in
Depth (ft):	97.1	Length to diameter ratio:	2.182
Moisture condition:	As received	Cross Sectional Area:	4.871 in^2
Rate of Loading:	65.4 lbs/sec	Failure Load:	23,080 lbs
Testing Time:	353 sec	Axial Strain at Failure:	0.0289 in/in
	(Rate 2-15 minutes to failure)	Stress:	4,737 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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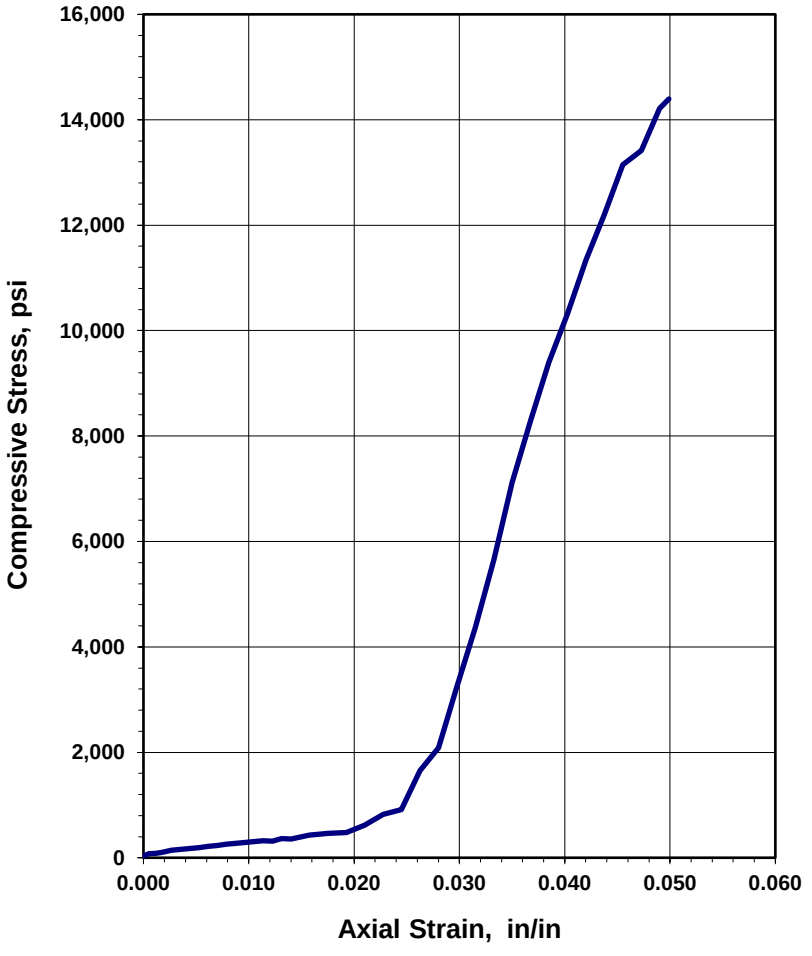
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 1/22/2015
Test Performed by: C.S./T.K.

Rock Description: Limestone, dolomitic

Boring No.:	B-113-2-13	Average Length:	5.713 in
Station / Offset:	245+03.67, 17.9' Lt.	Average Diameter:	2.484 in
Sample No. / Depth:	RC-1 / 91.5 ft	Length to diameter ratio:	2.300
Moisture condition:	As received	Cross Sectional Area:	4.844 in^2
Rate of Loading:	90.0 lbs/sec	Failure Load:	69,760 lbs
Testing Time:	775 sec	Axial Strain at Failure:	0.0499 in/in
	(Rate 2-15 minutes to failure)	Stress:	14,395 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Unconfined Compressive Strength

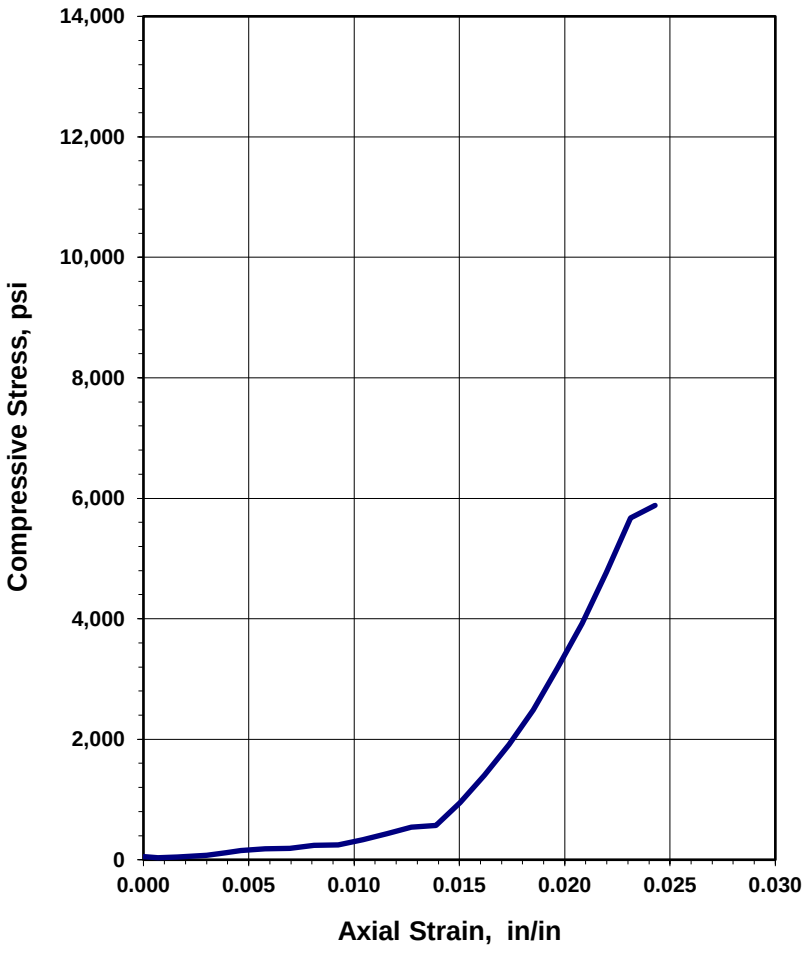
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 1/22/2015
Test Performed by: C.S./T.K.

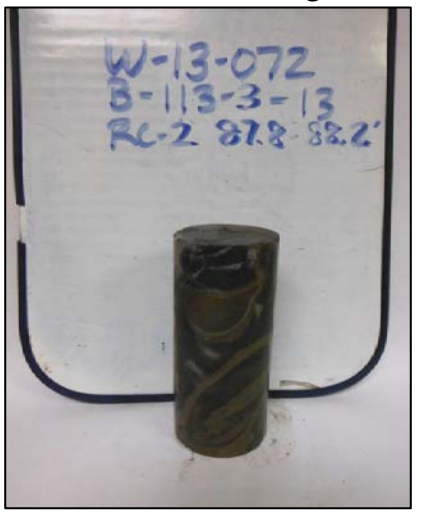
Rock Description: Limestone with chert nodules

Boring No.:	B-113-3-13	Average Length:	4.323 in
Station / Offset:	247+30.17, 35.7' Rt.	Average Diameter:	1.856 in
Sample No. / Depth:	RC-2 / 87.8 ft	Length to diameter ratio:	2.329
Moisture condition:	As received	Cross Sectional Area:	2.704 in^2
Rate of Loading:	55.8 lbs/sec	Failure Load:	15,910 lbs
Testing Time:	285 sec	Axial Strain at Failure:	0.0243 in/in
	(Rate 2-15 minutes to failure)	Stress:	5,882 psi

Unconfined Compression Test



Before Testing



After Failure

REMARKS:

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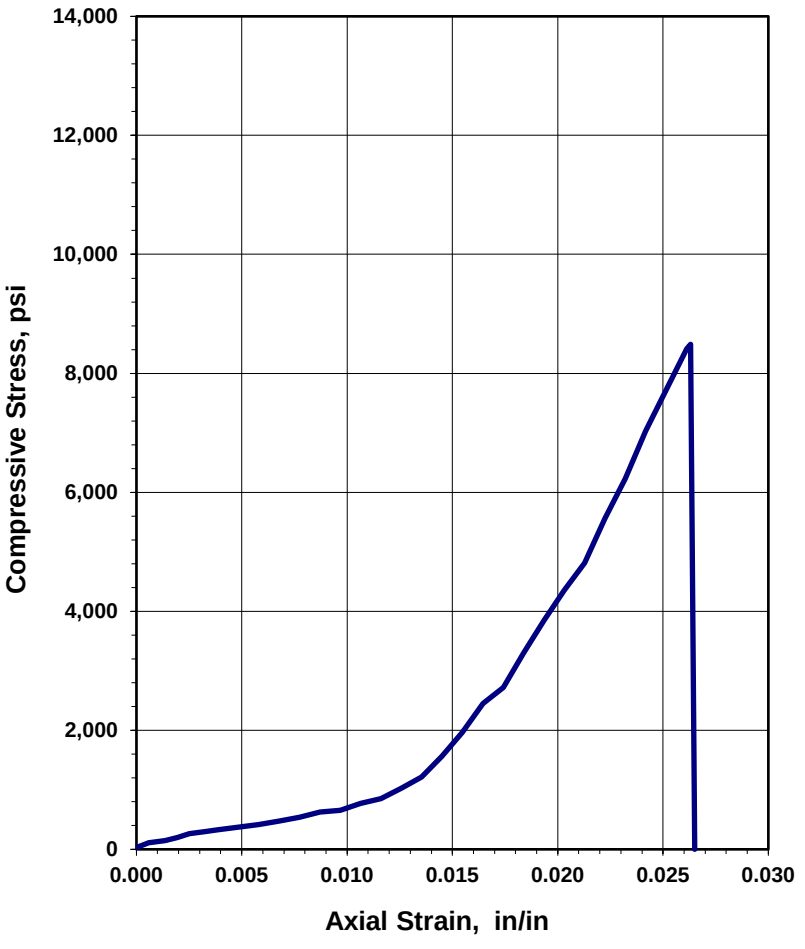
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 2/20/2014
Test Performed by: K.R./T.K.

Rock Description: Gray Limestone

Boring No.:	B-114-7-13	Average Length:	5.169 in
Station / Offset:	271+12.84, 28.4' Rt.	Average Diameter:	2.4 in
Sample No. / Depth:	RC-1 / 75.1 ft	Length to diameter ratio:	2.154
Moisture condition:	As received	Cross Sectional Area:	4.522 in^2
Rate of Loading:	67.1 lbs/sec	Failure Load:	38,390 lbs
Testing Time:	572 sec	Axial Strain at Failure:	0.0263 in/in
	(Rate 2-15 minutes to failure)	Stress:	8,488 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

RESOURCE INTERNATIONAL, INC.

Engineering Consultants

Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

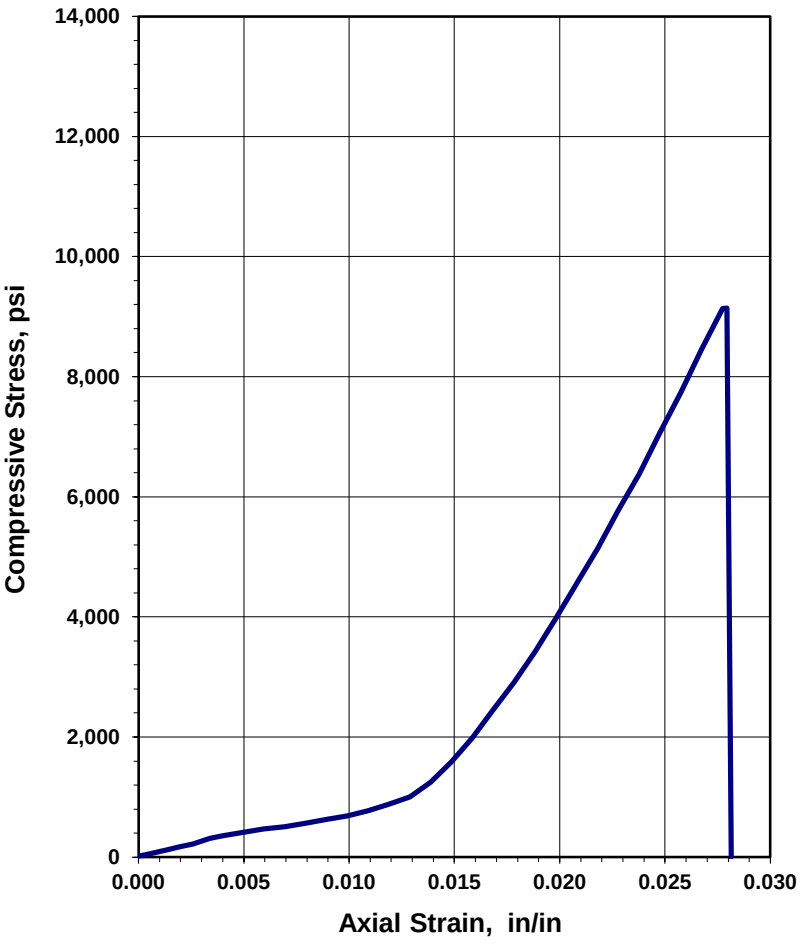
6350 Presidential Gatew.	9885 Rockside Road	4480 Lake Forest Drive
Columbus, OH 43231	Cleveland, OH 44125	Cincinnati, Ohio 45242
Phone (614) 823-4949	Phone (216) 573-0955	Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 2/20/2014
Test Performed by: K.R./T.K.

Rock Description: Gray Limestone

Boring No.:	B-114-7-13	Average Length:	5.047 in
Station / Offset:	271+12.84, 28.4' Rt.	Average Diameter:	2.397 in
Sample No. / Depth:	RC-2 / 81.5 ft	Length to diameter ratio:	2.106
Moisture condition:	As received	Cross Sectional Area:	4.510 in^2
Rate of Loading:	59.8 lbs/sec	Failure Load:	41,240 lbs
Testing Time:	690 sec	Axial Strain at Failure:	0.0279 in/in
	(Rate 2-15 minutes to failure)	Stress:	9,141 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Unconfined Compressive Strength

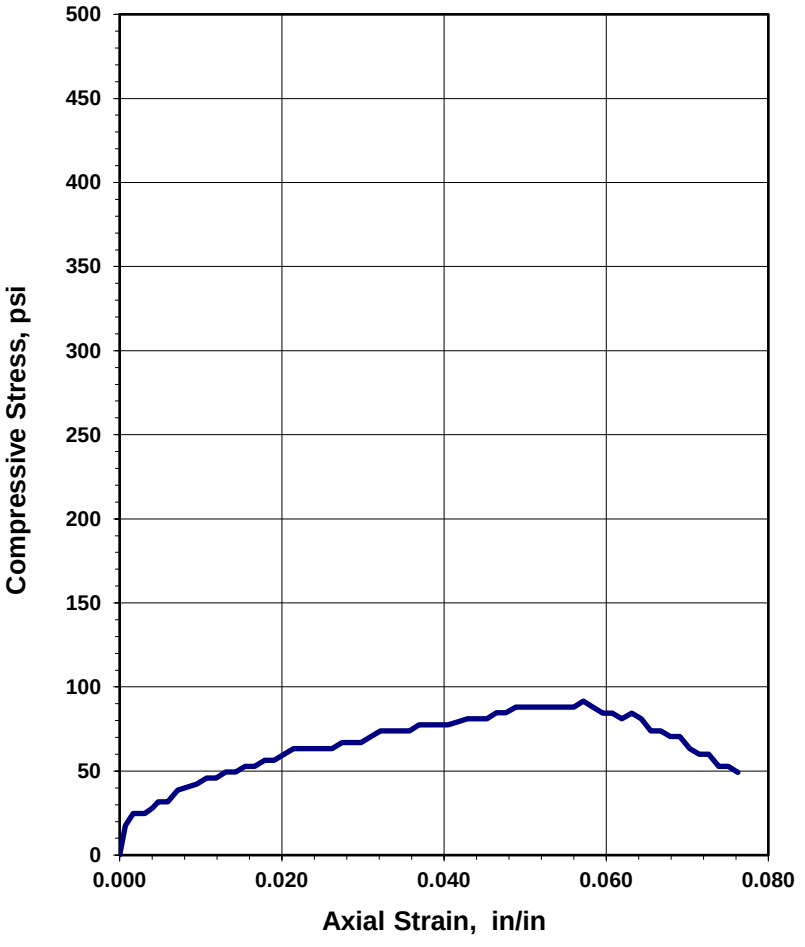
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 3/17/2014
Test Performed by: K.R./T.K.

Rock Description: Gray Claystone

Boring No.:	B-114-8-13	Average Length:	4.197 in
Station / Offset:	273+13.25, 16.5' Lt.	Average Diameter:	1.901 in
Sample No. / Depth:	RC-2 / 74.8 ft	Length to diameter ratio:	2.208
Moisture condition:	As received	Cross Sectional Area:	2.837 in^2
Rate of Loading:	0.3 lbs/sec	Failure Load:	260 lbs
Testing Time:	821 sec	Axial Strain at Failure:	0.0572 in/in
	(Rate 2-15 minutes to failure)	Stress:	92 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Phone (513) 769-6998

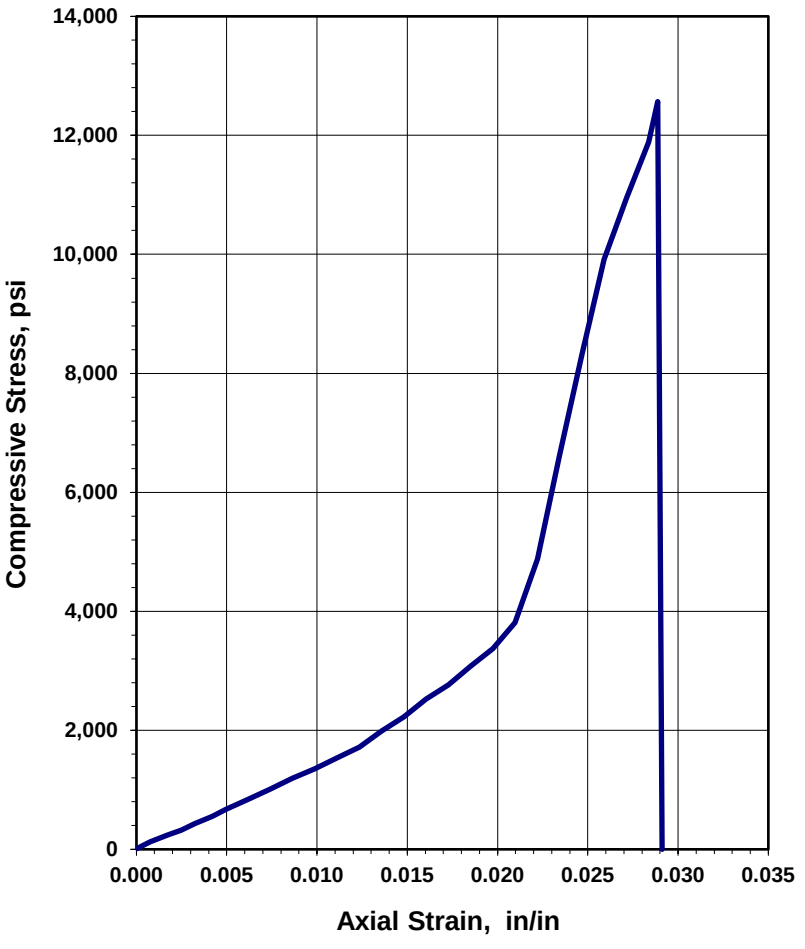
Unconfined Compressive Strength
of Intact Rock Core Specimens (ASTM D 7012-04)

Project: FRA-70-13.10 - Project 6A
Project No.: W-13-072
Date of Testing: 4/1/2014
Test Performed by: K.R./T.K.

Rock Description: Limestone

Boring No.:	B-114-8-13	Average Length:	4.053 in
Station / Offset:	273+13.25, 16.5' Lt.	Average Diameter:	1.869 in
Sample No. / Depth:	RC-3 / 78.4 ft	Length to diameter ratio:	2.169
Moisture condition:	As received	Cross Sectional Area:	2.742 in^2
Rate of Loading:	127.7 lbs/sec	Failure Load:	34,470 lbs
Testing Time:	270 sec	Axial Strain at Failure:	0.0289 in/in
	(Rate 2-15 minutes to failure)	Stress:	12,567 psi

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Point Load Strength Index of Rock Specimens

(ASTM D 5731-08)

Project: FRA-70-13.10
Project No.: W-13-072
Date of Testing: 2/2/2015
Test Performed by: E.M.

Rock Description: Gray Mudstone

Boring No.: B-020-7-13
Station / Offset: 176+68.64, 1.8' Rt.
Sample No. / Depth: RC-4 / 69.4' to 74.8'

Test Apparatus: Forney-LA 0080
Serial Number: A125/AZ/0014
Date of Calibration: 8/9/2014

Sample No.	Test Type	Depth (ft)	Width (mm)	Diameter (mm)	Load (N)	D_e^2 (mm^2)	D_e (mm)	F	Is (MPa)	$Is_{(50)}$ (MPa)	σ_c (MPa)
1	a ⊥	69.4	37.0	46.5	70	2,192	46.8	0.97	0.03	0.03	0.38
2	a ⊥	70.6	37.1	46.0	185	2,174	46.6	0.97	0.09	0.08	1.02
3	a ⊥	70.9	35.8	45.5	195	2,078	45.6	0.96	0.09	0.09	1.13
4	a ⊥	73.8	36.7	45.9	105	2,143	46.3	0.97	0.05	0.05	0.59
5	a ⊥	74.8	34.2	45.6	110	1,983	44.5	0.95	0.06	0.05	0.67
6											
7											
8											
9											
10											

STATISTICS	
Mean $Is_{(50)}$ ⊥	0.06 MPa (9 psi)
Mean $Is_{(50)}$ ‖	
$Ia_{(50)}$	

Specific Specimen Shape:

d = diametrical
a = axial
b = block
i = irregular lump
⊥ = perpendicular to bedding plane
‖ = parallel to bedding plane

Estimated Unaxial Compression, σ_c = K*Is

K = 12
*Per Section 206.1.3 of 2011 ODOT Rock Slope Design Guide

Mean σ_c = 0.76 MPa (110 psi)

Remarks:

APPENDIX V

GB1 SUBGRADE STABILIZATION ANALYSIS OUTPUTS

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70/71-13.10/14.36
89464 and 105523

I-70 WB - Sta. 182+00 to End Project

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Wednesday, February 19, 2020

Brian R. Trenner, PE
6350 Presidential Gateway
Columbus, Ohio 43231

614-823-4949
briant@resourceinternational.com

NO. OF BORINGS: 7

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-024-2-14	BL RAMP C5	5086+86	39	Lt	Mobile B-53	78	742.7	741.9	0.8 C
2	B-025-0-08	BL RAMP C5	5088+53	76	Lt	CME 75	61	740.4	738.2	2.2 C
3	B-026-3-13	BL RAMP C5	5091+05	12	Lt	CME-750	83	756.9	731.8	25.1 C
4	B-026-4-19	BL I-70WB	185+64	4	Rt	CME 750X	80	735.9	734.0	1.9 C
5	B-027-2-19	BL I-70WB	189+00	10	Lt	CME 750X	80	729.6	730.3	0.7 F
6	B-028-0-18	BL I-70WB	191+30	15	Lt	CME 75	61	731.7	733.0	1.3 F
7	B-029-1-19	BL I-70WB	193+00	10	Lt	CME 750X	80	735.7	735.3	0.4 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.7	2.2	32		4							12	10	A-4a	8						
	024-2	SS-2	3.5	5.0	2.7	4.2	17		4.5							10	10	A-4a	8						
	14	SS-3	6.0	7.5	5.2	6.7	21		2.75	22	13	9	30	20	50	11	10	A-4a							
		SS-4	8.5	10.0	7.7	9.2	13	17	4.5							10	10	A-4a							
2	B	SS-1	1.5	3.0	-0.7	0.8	30		4.5								14	A-6a	10						
	025-0	SS-2	3.5	5.0	1.3	2.8	24		4.5								10	A-4a	8						
	08	SS-3	6.0	7.5	3.8	5.3	19		4.5								10	A-4a	8						
		SS-4	8.5	10.0	6.3	7.8	21	19	4.5	20	18	2	32	22	54	9	13	A-4a							
3	B	SS-10	23.5	25.0	-1.6	-0.1	32									9	6	A-1-b	0						
	026-3	SS-11	26.0	27.5	0.9	2.4	30									7	6	A-1-b	0						
	13	SS-12	28.5	30.0	3.4	4.9	37									7	6	A-1-b	0						
								30																	
4	B	SS-1	2.2	3.7	0.3	1.8	32			21	17	4	19	5	24	9	6	A-1-b	0	310					
	026-4	SS-2	3.7	5.2	1.8	3.3	38			21	18	3	19	4	23	7	6	A-1-b	0						
	19	SS-3	5.2	6.7	3.3	4.8	34									7	6	A-1-b	0						
		SS-4	6.7	8.2	4.8	6.3	25	25								7	6	A-1-b	0						
5	B	SS-1	1.9	3.4	2.6	4.1	44			0	0	NP	15	4	19	4	6	A-1-b	0	3800					
	027-2	SS-2	3.4	4.9	4.1	5.6	28			0	0	NP	13	1	14	5	8	A-3a	0						
	19	SS-3	4.9	6.4	5.6	7.1	34									7	8	A-3a							
		SS-4	6.4	7.9	7.1	8.6	40	28								14	8	A-3a							
6	B	SS-1	1.5	3.0	2.8	4.3	13			0	0	NP	13	0	13	6	6	A-1-a	0						
	028-0	SS-2	3.5	5.0	4.8	6.3	7			0	0	NP	11	0	11	7	6	A-1-a	0						
	18	SS-3	6.0	7.5	7.3	8.8	42			0	0	NP	17	0	17	8	6	A-1-b							
		SS-4	8.5	10.0	9.8	11.3	50	7		0	0	NP	8	0	8	3	6	A-1-a							
7	B	SS-1	1.9	3.4	1.5	3.0	36		4.5	23	14	9	40	23	63	10	10	A-4a	6	540					
	029-1	SS-2	3.4	4.9	3.0	4.5	29		4.5	23	14	9	40	27	67	10	10	A-4a	6						
	19	SS-3	4.9	6.4	4.5	6.0	49		4.5							10	10	A-4a	8						
		SS-4	6.4	7.9	6.0	7.5	42	29	4.5							11	10	A-4a							

PID: 89464 and 1

County-Route-Section: FRA-70/71-13.10/14.36

No. of Borings: 7

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/19/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	NA

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	0"
Average(HP):	0"
Global Geogrid Average(N60L):	0"
Average(HP):	0"

Design CBR	9

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	5%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	5%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	81%	HP > 2	48%
M+	0%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

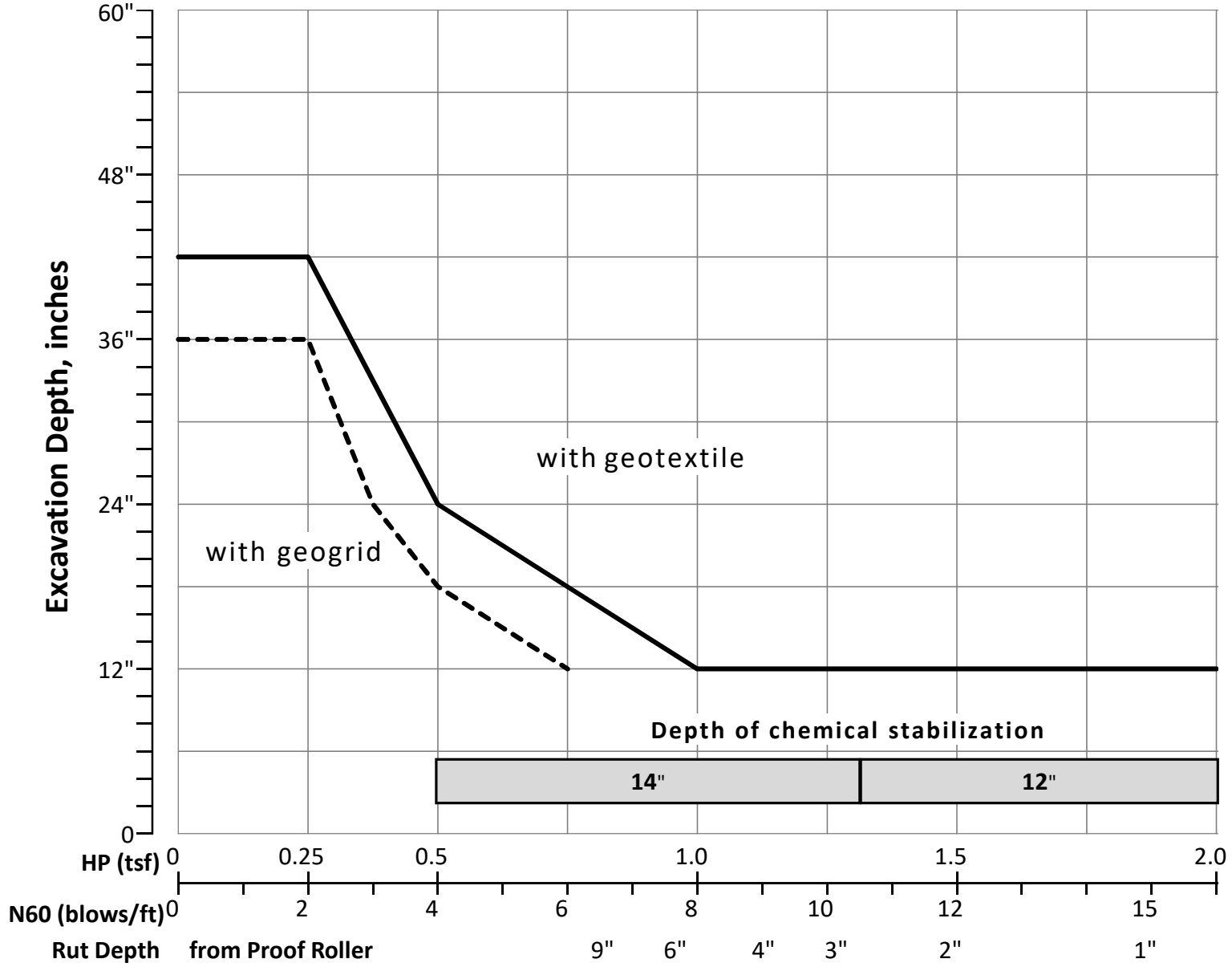
% Proposed Subgrade Surface	
Unstable & Unsuitable	0%
Unstable	0%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	30	22	4.31	11	8	6	21	9	30	8	8	3
Maximum	50	30	4.50	23	18	9	40	27	67	14	14	10
Minimum	7	7	2.75	0	0	2	8	0	8	3	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	3	8	0	0	0	0	0	3	11	0	0	1	0	0	0	0	0	26
Percent	0%	12%	31%	0%	0%	0%	0%	0%	12%	42%	0%	0%	4%	0%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	96%									4%								100%
Surface Class Count	0	1	5	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	11
Surface Class Percent	0%	9%	45%	0%	0%	0%	0%	0%	0%	36%	0%	0%	9%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
4.31		☐ HP
22.14		☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70/71-13.10/14.36
89464 and 105588

I-71 SB - Begin Project to Sta. 221+10

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Wednesday, February 19, 2020

Brian R. Trenner, PE
6350 Presidential Gateway
Columbus, Ohio 43231

614-823-4949
briant@resourceinternational.com

NO. OF BORINGS: 7

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-095-0-09	BL I-71 SB	203+06	121	Rt	CME 75	61	718.0	720.2	2.2 F
2	B-096-1-09	BL I-7 1SB	206+96	14	Rt	CME 75	61	713.8	715.1	1.3 F
3	B-097-0-09	BL I-71 SB	210+75	143	Rt	CME 75	61	720.2	717.1	3.1 C
4	B-098-1-09	BL I-71 SB	214+88	15	Rt	CME 75	61	718.6	720.1	1.5 F
5	B-099-0-09	BL I-71 SB	218+99	143	Rt	CME 75	61	722.1	718.6	3.5 C
6	B-099-4-14	BL I-71 SB	221+70	45	Rt	BK 81 HD	72	717.0	718.6	1.6 F
7	B-100-0-09	BL I-71 SB	222+98	6	Rt	CME 75	61	716.6	720.2	3.6 F

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	3.7	5.2	20		2	38	19	19	39	35	74	20	16	A-6b	11						
	095-0	SS-2	3.5	5.0	5.7	7.2	16									7	10	A-4a							
	09	SS-3	6.0	7.5	8.2	9.7	13		1	35	20	15	38	34	72	21	15	A-6a							
		SS-4	8.5	10.0	10.7	12.2	20	16	2							22	14	A-6a							
2	B	SS-1	1.5	3.0	2.8	4.3	15			0	0	NP	13	0	13	7	6	A-1-b	0						
	096-1	SS-2	3.5	5.0	4.8	6.3	9		1.75							25	14	A-6a	10						
	09	SS-3	6.0	7.5	7.3	8.8	11		1	28	17	11	38	22	60	18	14	A-6a							
		SS-4	8.5	10.0	9.8	11.3	14	9								12	10	A-2-6							
3	B	SS-2	3.0	4.5	-0.1	1.4	14			0	0	NP	13	9	22	8	6	A-1-b	0						
	097-0	SS-3	4.5	6.0	1.4	2.9	12			0	0	NP	9	0	9	5	6	A-1-a	0						
	09	SS-4	6.0	7.5	2.9	4.4	3		0.8	31	15	16	24	26	50	25	16	A-6b	5						
		SS-5	8.5	10.0	5.4	6.9	2	2	0.5							16	14	A-6a							
4	B	SS-1	1.0	2.5	2.5	4.0	35		2	33	17	16	23	23	46	16	16	A-6b	4						
	098-1	SS-2	3.5	5.0	5.0	6.5	19		3.5							15	10	A-4a	8						
	09	SS-3	6.0	7.5	7.5	9.0	29			0	0	NP	12	0	12	4	6	A-1-a							
		SS-4	8.5	10.0	10.0	11.5	49	19								3	6	A-1-a							
5	B	SS-2	3.0	4.5	-0.5	1.0	10			0	0	NP	17	0	17	8	6	A-1-b	0						
	099-0	SS-3	4.5	6.0	1.0	2.5	5		1	27	16	11	25	17	42	18	14	A-6a	2			HP & Mc		**21"**	
	09	SS-4	6.0	7.5	2.5	4.0	4		0.75	25	18	7	17	15	32	13	13	A-4a	0						
		SS-5	8.5	10.0	5.0	6.5	4	4	0.75							24	10	A-4a	8						
6	B	SS-1	1.0	2.5	2.6	4.1	14		2.5							12	18	A-7-6	16						
	099-4	SS-2	3.5	5.0	5.1	6.6	17		2.5	43	18	25	25	21	46	17	18	A-7-6							
	14	SS-3	6.0	7.5	7.6	9.1	58		2.5							15	18	A-7-6							
		SS-4	8.5	10.0	10.1	11.6	29	14	3							13	18	A-7-6							
7	B	SS-1	1.5	3.0	5.1	6.6	9									4	6	A-1-a							
	100-0	SS-2	3.0	4.5	6.6	8.1	7			0	0	NP	9	0	9	12	6	A-1-a							
	09	SS-3	4.5	6.0	8.1	9.6	7			0	0	NP	17	0	17	14	6	A-1-a							
		SS-4	6.0	7.5	9.6	11.1	55	9	1	24	16	8	30	23	53	14	11	A-4a							

PID: 89464 and 1

County-Route-Section: FRA-70/71-13.10/14.36

No. of Borings: 7

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/19/2020

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	12''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	8

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	29%	HP ≤ 0.5	6%
$N_{60} < 12$	47%	0.5 < HP ≤ 1	24%
$12 \leq N_{60} < 15$	18%	1 < HP ≤ 2	18%
$N_{60} \geq 20$	12%	HP > 2	18%
M+	6%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

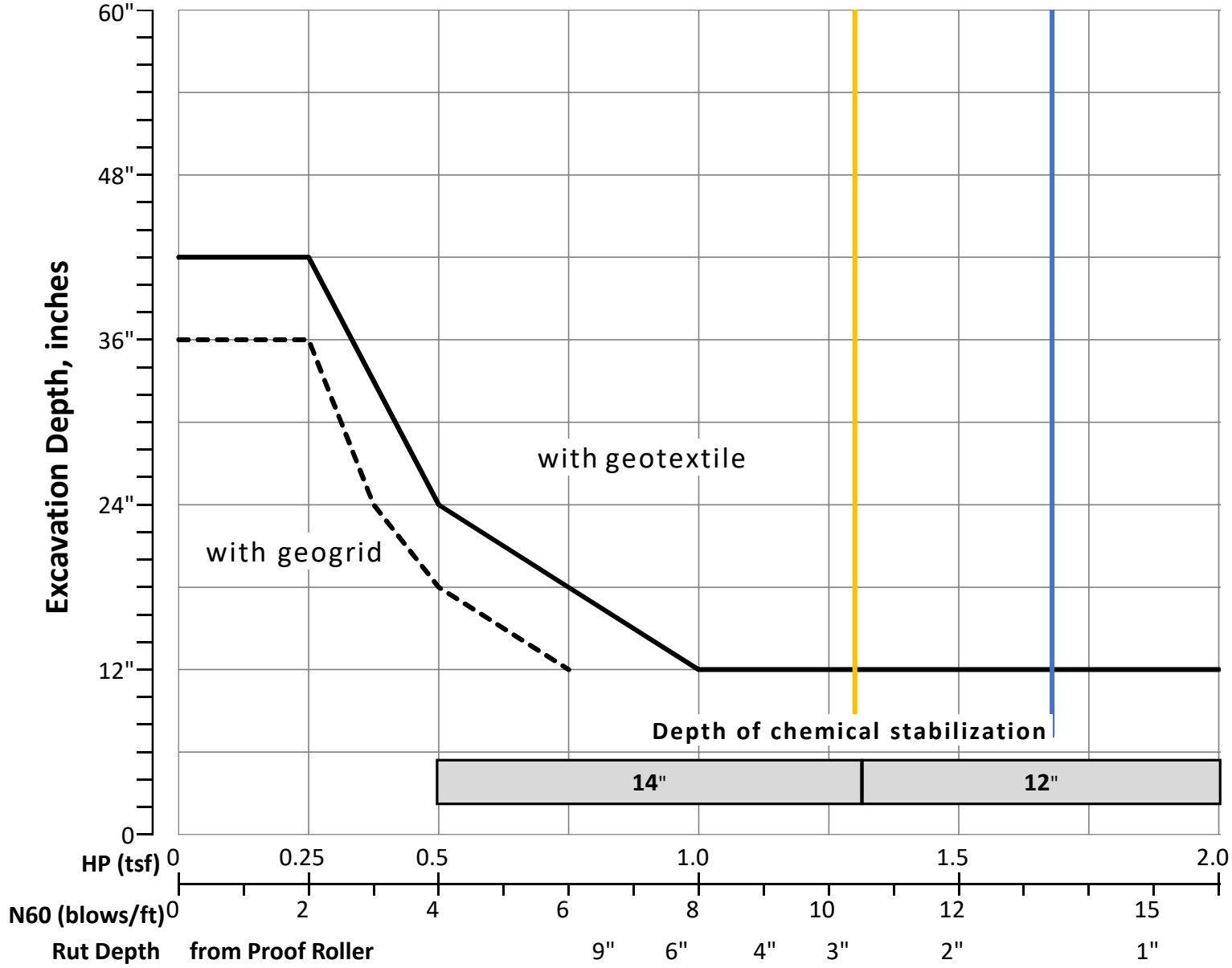
% Proposed Subgrade Surface	
Unstable & Unsuitable	14%
Unstable	14%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	18	10	1.68	18	10	14	22	14	36	14	12	5
Maximum	58	19	3.50	43	20	25	39	35	74	25	18	16
Minimum	2	2	0.50	0	0	7	9	0	9	3	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	6	3	0	0	1	0	0	0	5	0	0	6	3	0	4	0	0	28
Percent	0%	21%	11%	0%	0%	4%	0%	0%	0%	18%	0%	0%	21%	11%	0%	14%	0%	0%	100%
% Rock|Granular|Cohesive	0%	54%									46%								100%
Surface Class Count	0	1	2	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	7
Surface Class Percent	0%	14%	29%	0%	0%	0%	0%	0%	0%	14%	0%	0%	14%	14%	0%	14%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
1.68		☐ HP
10.43		☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70/71-13.10/14.36
89464 and 105588

Ramp B3

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Wednesday, February 19, 2020

Brian R. Trenner, PE
6350 Presidntial Gateway
Columbus, Ohio 43231

614-823-4949
briant@resourceinternational.com

NO. OF BORINGS: 5

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-091-0-09	BL RAMP B3	3000+75	10	Lt	CME 75	61	705.2	704.2	1.0 C
2	B-092-0-09	BL I-71 NB	685+50	80	Lt	CME 75	61	724.9	710.2	14.7 C
3	B-095-0-09	BL I-71 NB	203+06	121	Rt	CME 75	61	718.0	715.8	2.2 C
4	B-096-1-09	BL I-71 NB	206+96	14	Rt	CME 75	61	713.8	717.9	4.1 F
5	B-097-0-09	BL I-71 NB	210+75	143	Rt	CME 75	61	720.2	716.6	3.6 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.0	2.5	0.0	1.5	15			31	17	14	31	22	53	12	14	A-6a	5						
	091-0	SS-2	2.5	4.0	1.5	3.0	6			0	0	NP	7	0	7	4	6	A-1-b	0						
	09	SS-3	4.0	5.5	3.0	4.5	10		2.25	38	19	19	44	40	84	23	16	A-6b	12						
		SS-4	5.5	7.0	4.5	6.0	10	6	1.75	37	18	19	45	40	85	26	16	A-6b	12						
2	B	SS-7	16.0	17.5	1.3	2.8	37		3.5							30	14	A-6a	10			Mc			
	092-0	SS-8	18.5	20.0	3.8	5.3	29		4.5	30	17	13	37	29	66	18	14	A-6a	7						
	09	SS-9	21.0	22.5	6.3	7.8	50										14	A-6a							
		SS-10	23.5	25.0	8.8	10.3	21	29	3.25							22	14	A-6a							
3	B	SS-1	1.5	3.0	-0.7	0.8	20		2	38	19	19	39	35	74	20	16	A-6b	11			Mc			
	095-0	SS-2	3.5	5.0	1.3	2.8	16									7	10	A-4a	8						
	09	SS-3	6.0	7.5	3.8	5.3	13		1	35	20	15	38	34	72	21	15	A-6a	9						
		SS-4	8.5	10.0	6.3	7.8	20	13	2							22	14	A-6a							
4	B	SS-1	1.5	3.0	5.6	7.1	15			0	0	NP	13	0	13	7	6	A-1-b							
	096-1	SS-2	3.5	5.0	7.6	9.1	9		1.75							26	14	A-6a							
	09	SS-3	6.0	7.5	10.1	11.6	11		1	28	17	11	38	22	60	18	14	A-6a							
		SS-4	8.5	10.0	12.6	14.1	14	15								12	10	A-2-6							
5	B	SS-2	3.0	4.5	-0.6	0.9	14			0	0	NP	13	9	22	8	6	A-1-b	0						
	097-0	SS-3	4.5	6.0	0.9	2.4	12			0	0	NP	9	0	9	6	6	A-1-a	0						
	09	SS-4	6.0	7.5	2.4	3.9	3		0.75	31	15	16	24	26	50	25	16	A-6b	5						
		SS-5	8.5	10.0	4.9	6.4	2	2	0.5							16	14	A-6a	10						

PID: 89464 and 1

County-Route-Section: FRA-70/71-13.10/14.36

No. of Borings: 5

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/19/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	12"

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L): Average(HP):	 12" 12"
Global Geogrid Average(N60L): Average(HP):	 0" 0"

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	14%	HP ≤ 0.5	7%
$N_{60} < 12$	36%	0.5 < HP ≤ 1	14%
$12 \leq N_{60} < 15$	21%	1 < HP ≤ 2	14%
$N_{60} \geq 20$	21%	HP > 2	21%
M+	14%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

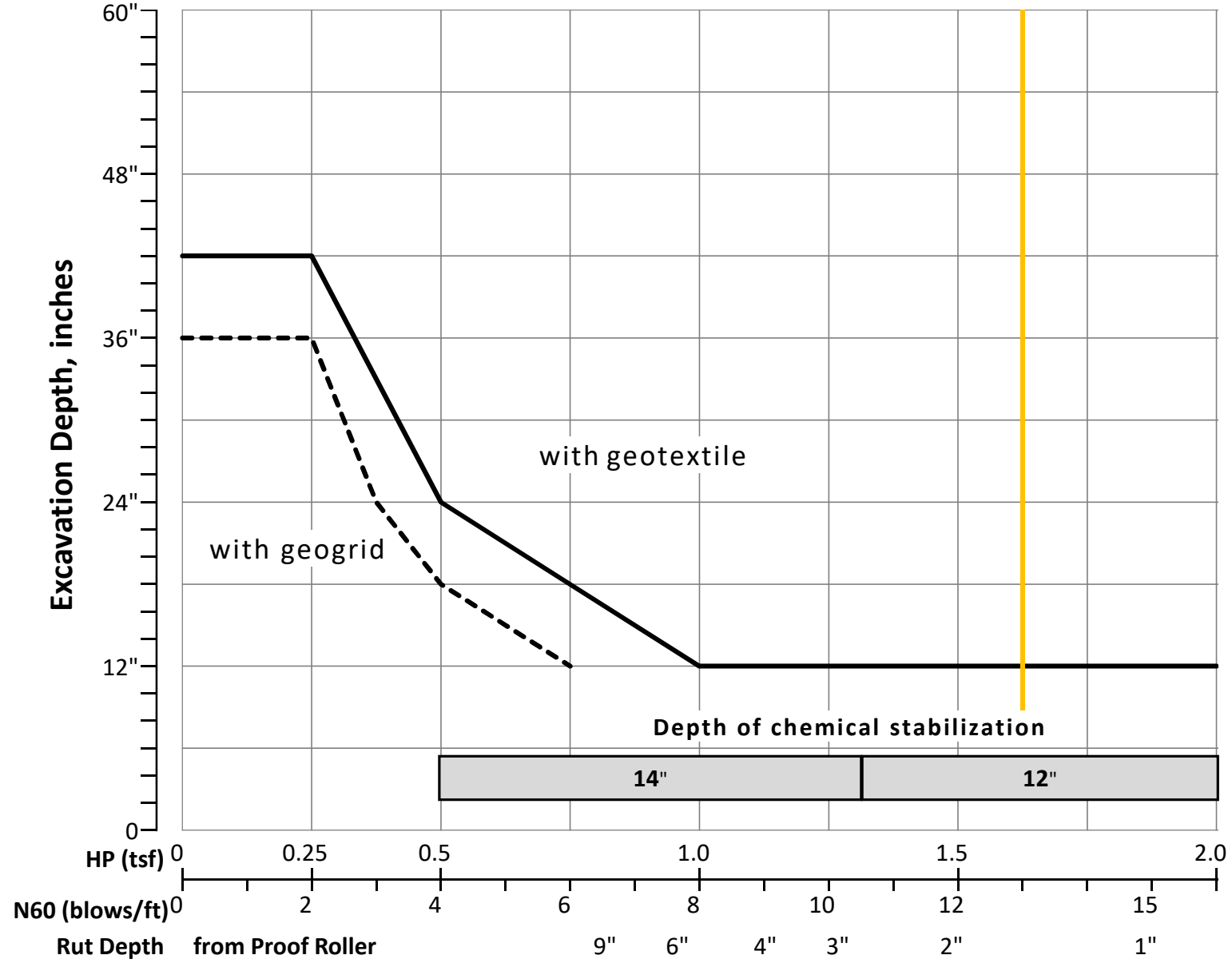
% Proposed Subgrade Surface	
Unstable & Unsuitable	25%
Unstable	25%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	16	13	2.02	22	12	16	28	21	50	17	12	7
Maximum	50	29	4.50	38	20	19	45	40	85	30	16	12
Minimum	2	2	0.50	0	0	11	7	0	7	4	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	1	3	0	0	1	0	0	0	1	0	0	10	4	0	0	0	0	20
Percent	0%	5%	15%	0%	0%	5%	0%	0%	0%	5%	0%	0%	50%	20%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	30%									70%								100%
Surface Class Count	0	1	2	0	0	0	0	0	0	1	0	0	2	2	0	0	0	0	8
Surface Class Percent	0%	13%	25%	0%	0%	0%	0%	0%	0%	13%	0%	0%	25%	25%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.02		☐ HP
13.00		☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70/71-13.10/14.36
89464 and 105588

Ramp D3N

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Wednesday, February 19, 2020

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6350 Presidential Gateway
Columbus, Ohio 43231

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NO. OF BORINGS: 3

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-113-2-13	BL I-71 SB	245+04	18	Lt	CME-55	92	743.3	732.6	10.7 C
2	B-113-3-13	BL I-71 SB	247+30	36	Rt	CME-55	92	735.3	737.3	2.0 F
3	B-115-0-09	BL RAMP D3 N	833+32	18	Rt	CME 75	61	711.2	707.5	3.7 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-3	13.5	15.0	2.8	4.3	74									7	6	A-1-b	0						
	113-2	SS-4	18.5	20.0	7.8	9.3	15										6	A-1-b							
	13	SS-5	23.5	25.0	12.8	14.3	48			22	15	7	14	10	24	8	10	A-2-4							
								30																	
2	B	SS-1	1.0	2.5	3.0	4.5	11									11	8	A-3a	0						
	113-3	SS-2	3.5	5.0	5.5	7.0	20		2.5	26	17	9	25	18	43	13	12	A-4a							
	13	SS-3	8.5	10.0	10.5	12.0	50									7	10	A-2-4							
		SS-4	13.5	15.0	15.5	17.0	43	11		24	15	9	13	13	26	7	10	A-2-4							
3	B	SS-2	3.5	5.0	-0.2	1.3	13		3	34	13	21	31	29	60	18	16	A-6b	9						
	115-0	SS-3	6.0	7.5	2.3	3.8	15		1.5							14	16	A-6b	16						
	09	SS-4	8.5	10.0	4.8	6.3	7		2							28	14	A-6a	10						
		SS-5	11.0	12.5	7.3	8.8	14	7	2.75	32	18	14	46	40	86	21	14	A-6a							

PID: 89464 and 1

County-Route-Section: FRA-70/71-13.10/14.36

No. of Borings: 3

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/19/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	NA

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12"
Average(HP):	0"
Global Geogrid Average(N60L):	0"
Average(HP):	0"

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	33%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	17%	1 < HP ≤ 2	33%
$N_{60} \geq 20$	33%	HP > 2	33%
M+	0%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

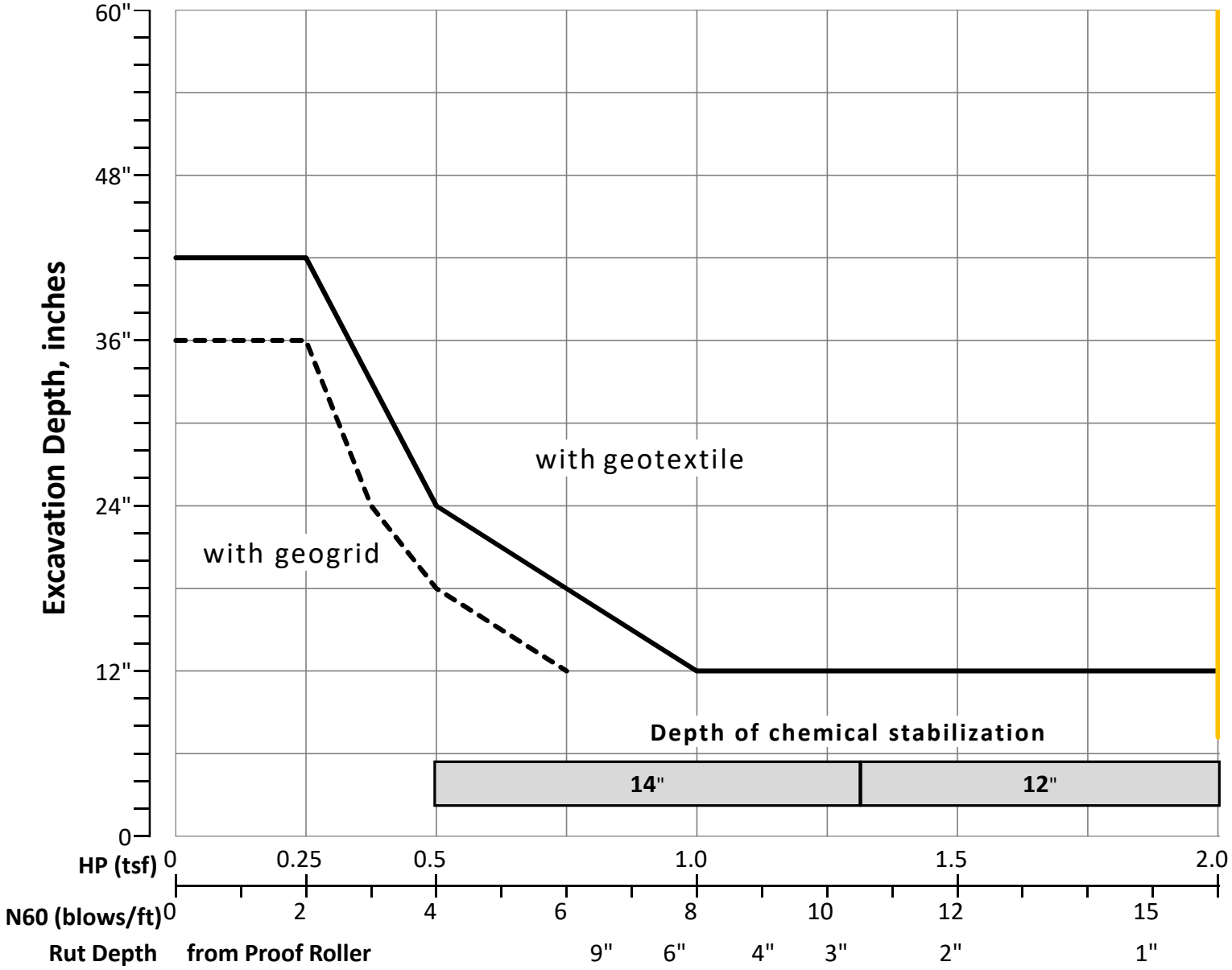
% Proposed Subgrade Surface	
Unstable & Unsuitable	0%
Unstable	0%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	28	16	2.35	28	16	12	26	22	48	13	11	7
Maximum	74	30	3.00	34	18	21	46	40	86	28	16	16
Minimum	7	7	1.50	22	13	7	13	10	24	7	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	2	3	0	0	0	0	1	1	0	0	2	2	0	0	0	0	11
Percent	0%	0%	18%	27%	0%	0%	0%	0%	9%	9%	0%	0%	18%	18%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	64%									36%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.35		☐ HP
16.00		☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70-71-13.10/14.36
89464 and 105588

W. Mound Street

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Thursday, February 20, 2020

Brian R. Trenner, PE
6350 Presidential Gateway
Columbus, Ohio 43231

614-823-4949
briant@resourceinternational.com

NO. OF BORINGS: 7

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-114-7-13	BL I-71 SB	271+13	28	Rt	CME-750	83	713.3	712.0	1.3 C
2	B-114-8-13	BL I-71 SB	273+13	17	Lt	MOBILE B-53	78	714.0	712.1	1.9 C
3	B-020-4-13	BL RAMP D7	7007+78	12	Rt	MOBILE B-53	78	714.0	712.2	1.8 C
4	B-020-6-13	BL RAMP D7	7008+36	24	Rt	CME-55	92	714.1	713.6	0.5 C
5	B-020-8-13	BL RAMP D7	7010+16	31	Rt	CME-55	92	721.0	718.8	2.2 C
6	B-021-3-13	BL RAMP D7	7011+57	21	Rt	MOBILE B-53	78	727.0	725.9	1.1 C
7	B-023-2-13	BL RAMP D7	7012+74	45	Rt	MOBILE B-53	78	733.1	731.5	1.6 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.0	2.5	-0.3	1.2	51		3.25	33	19	14	22	19	41	12	14	A-6a	2						
	114-7	SS-2	3.5	5.0	2.2	3.7	21		3							11	14	A-6a	10						
	13	SS-3	6.0	7.5	4.7	6.2	11		3	41	20	21	43	47	90	22	18	A-7-6	13						
		SS-4	8.5	10.0	7.2	8.7	18	11	3.25							25	18	A-7-6							
2	B	SS-1	1.0	2.5	-0.9	0.6	21		4.5							14	10	A-4a	8			Mc			
	114-8	SS-2	3.5	5.0	1.6	3.1	21		3	32	22	10	25	18	43	17	17	A-4a	2						
	13	SS-3	6.0	7.5	4.1	5.6	4		1.75							24	16	A-6b	16						
		SS-4	8.5	10.0	6.6	8.1	17	4	2.25							21	16	A-6b							
3	B	SS-1	1.0	2.5	-0.8	0.7	4		1.25							25	14	A-6a	10			HP & Mc		**24"**	
	020-4	SS-2	3.5	5.0	1.7	3.2	4		1.25	32	18	14	31	25	56	28	14	A-6a	6			HP & Mc			
	13	SS-3	6.0	7.5	4.2	5.7	8		2.5							25	14	A-6a	10						
		SS-4	8.5	10.0	6.7	8.2	14	4	3.5	48	20	28	53	41	94	29	18	A-7-6							
4	B	SS-1	1.0	2.5	0.5	2.0	12		1.5	33	20	13	32	23	55	21	15	A-6a	5			HP & Mc		**12"**	
	020-6	SS-2	3.5	5.0	3.0	4.5	9		1.25							24	14	A-6a	10						
	13	SS-3	6.0	7.5	5.5	7.0	18			0	0	NP	1	0	1	6	6	A-1-a							
		SS-4	8.5	10.0	8.0	9.5	8	9								14	6	A-1-a							
5	B	SS-2	3.5	5.0	1.3	2.8	8			28	18	10	13	16	29	15	10	A-2-4	0			N_{60} & Mc			
	020-8	SS-3	6.0	7.5	3.8	5.3	23									1	6	A-1-a	0						
	13	SS-4	8.5	10.0	6.3	7.8	50										6	A-1-a							
		SS-5	11.0	12.5	8.8	10.3	44	8		20	19	1	3	4	7	6	6	A-1-a							
6	B	SS-1	1.0	2.5	-0.1	1.4	14		1.75	28	16	12	30	23	53	8	14	A-6a	4						
	021-3	SS-2	3.5	5.0	2.4	3.9	38									5	6	A-1-b	0						
	13	SS-3	6.0	7.5	4.9	6.4	41									5	6	A-1-b	0						
		SS-4	8.5	10.0	7.4	8.9	34	14								6	6	A-1-b							
7	B	SS-1	3.5	5.0	1.9	3.4	25									6	6	A-1-b	0						
	023-2	SS-2	6.0	7.5	4.4	5.9	17		2.5	25	16	9	44	30	74	17	11	A-4a	8						
	13	SS-3	8.5	10.0	6.9	8.4	25									8	6	A-1-a							
		SS-4	11.0	12.5	9.4	10.9	13	17		21	16	5	9	18	27	10	10	A-2-4							

PID: 89464 and 1

County-Route-Section: FRA-70-71-13.10/14.36

No. of Borings: 7

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/20/2020

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	16%	HP ≤ 0.5	0%
$N_{60} < 12$	37%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	11%	1 < HP ≤ 2	32%
$N_{60} \geq 20$	42%	HP > 2	37%
M+	26%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

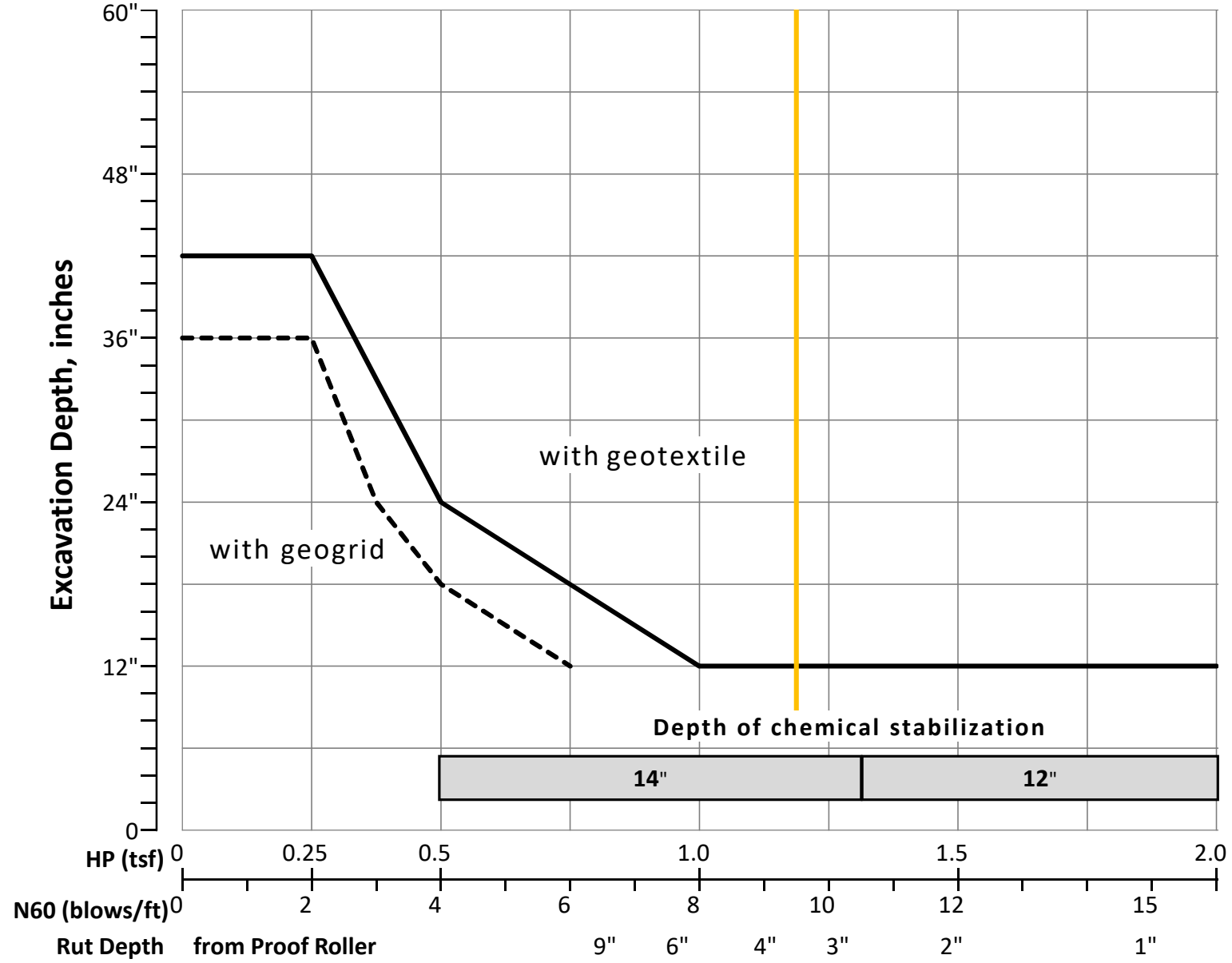
% Proposed Subgrade Surface	
Unstable & Unsuitable	45%
Unstable	45%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	20	10	2.47	28	17	12	26	22	48	15	11	6
Maximum	51	17	4.50	48	22	28	53	47	94	29	18	16
Minimum	4	4	1.25	0	0	1	1	0	1	1	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	6	4	2	0	0	0	0	0	3	0	0	8	2	0	3	0	0	28
Percent	0%	21%	14%	7%	0%	0%	0%	0%	0%	11%	0%	0%	29%	7%	0%	11%	0%	0%	100%
% Rock|Granular|Cohesive	0%	54%									46%								100%
Surface Class Count	0	0	2	1	0	0	0	0	0	2	0	0	6	0	0	0	0	0	11
Surface Class Percent	0%	0%	18%	9%	0%	0%	0%	0%	0%	18%	0%	0%	55%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.47		☐ HP
9.57		☐ N60L

Average HP
Average N_{60L}

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70/71-13.10/14.36
89464 and 105588

Short Street

Resource International, Inc.

Prepared By: HSK/BRT
Date prepared: Thursday, February 20, 2020

Brian R. Trenner, PE
6350 Presidential Gateway
Columbus, Ohio 43231

614-823-4949
briant@resourceinternational.com

NO. OF BORINGS: 6

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-020-9-15	BL RAMP C5	5081+05	40	Rt	CME 55	92	713.0	711.2	1.8 C
2	B-020-2-13	BL I-70 EB	176+14	24	Rt	CME-750	83	711.4	711.5	0.1 F
3	B-020-7-13	BL I-70 WB	176+69	2	Rt	CME-55-LC	73	713.5	711.8	1.7 C
4	B-115-1-13	BL I-70 SB	276+68	2	Rt	CME 750X	86	714.6	712.1	2.5 C
5	B-020-6-13	BL RAMP D7	7008+36	24	Rt	CME-55	92	714.1	712.3	1.8 C
6	B-020-4-13	BL RAMP D7	7007+78	12	Rt	MOBILE B-53	78	714.0	712.4	1.6 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.0	2.5	-0.8	0.7	11		1.25							22	14	A-6a	10			HP & Mc		12"	
	020-9	SS-2	3.5	4.0	1.7	2.2	12		1.5	35	20	15	37	29	66	18	15	A-6a	8			HP & Mc			
	15	SS-3	6.0	7.5	4.2	5.7	9		2							37	16	A-6b	16						
		SS-4	8.5	10.0	6.7	8.2	15	9	2	34	18	16	50	36	86	21	16	A-6b							
2	B	SS-1	1.0	2.5	1.1	2.6	19		1.75							16	14	A-6a	10						
	020-2	SS-2	3.5	5.0	3.6	5.1	4			26	23	3	19	6	25	15	6	A-1-b	0						
	13	SS-3	6.0	7.5	6.1	7.6	15		2							15	6	A-1-b							
		SS-4	8.5	10.0	8.6	10.1	7	4	1	39	20	19	54	37	91	25	16	A-6b							
3	B	SS-1	1.0	2.5	-0.7	0.8	10									12	10	A-2-4	0			N_{60}		12"	
	020-7	SS-2	3.5	5.0	1.8	3.3	6			0	0	NP	19	8	27	13	10	A-2-4	0			N_{60} & Mc			
	13	SS-3	8.5	10.0	6.8	8.3	12									23	18	A-7-6							
								6																	
4	B	SS-2	3.5	5.0	1.0	2.5	13		3.5	32	22	10	42	21	63	21	17	A-4a	6			N_{60} & Mc		12"	
	115-1	SS-3	6.0	7.5	3.5	5.0	19		4.5							17	14	A-6a	10						
	13	SS-4	8.5	10.0	6.0	7.5	16		4.5	33	22	11	33	28	61	16	17	A-6a							
		SS-5	11.0	12.5	8.5	10.0	14	13								2	6	A-1-a							
5	B	SS-1	1.0	2.5	-0.8	0.7	12		1.5	33	20	13	32	23	55	21	15	A-6a	5			HP & Mc		12"	
	020-6	SS-2	3.5	5.0	1.7	3.2	9		1.25							24	14	A-6a	10			HP & Mc			
	13	SS-3	6.0	7.5	4.2	5.7	18			0	0	NP	1	0	1	6	6	A-1-a	0						
		SS-4	8.5	10.0	6.7	8.2	8	9								14	6	A-1-a							
6	B	SS-1	1.0	2.5	-0.6	0.9	4		1.25							25	14	A-6a	10			HP & Mc		24"	
	020-4	SS-2	3.5	5.0	1.9	3.4	4		1.25	32	18	14	31	25	56	28	14	A-6a	6			HP & Mc			
	13	SS-3	6.0	7.5	4.4	5.9	8		2.5							25	14	A-6a	10						
		SS-4	8.5	10.0	6.9	8.4	14	4	3.5	48	20	28	53	41	94	29	18	A-7-6							

PID: 89464 and 1

County-Route-Section: FRA-70/71-13.10/14.36

No. of Borings: 6

Geotechnical Consultant: Resource International, Inc.

Prepared By: HSK/BRT

Date prepared: 2/20/2020

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	15''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	19%	HP ≤ 0.5	0%
$N_{60} < 12$	56%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	19%	1 < HP ≤ 2	50%
$N_{60} \geq 20$	0%	HP > 2	25%
M+	50%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

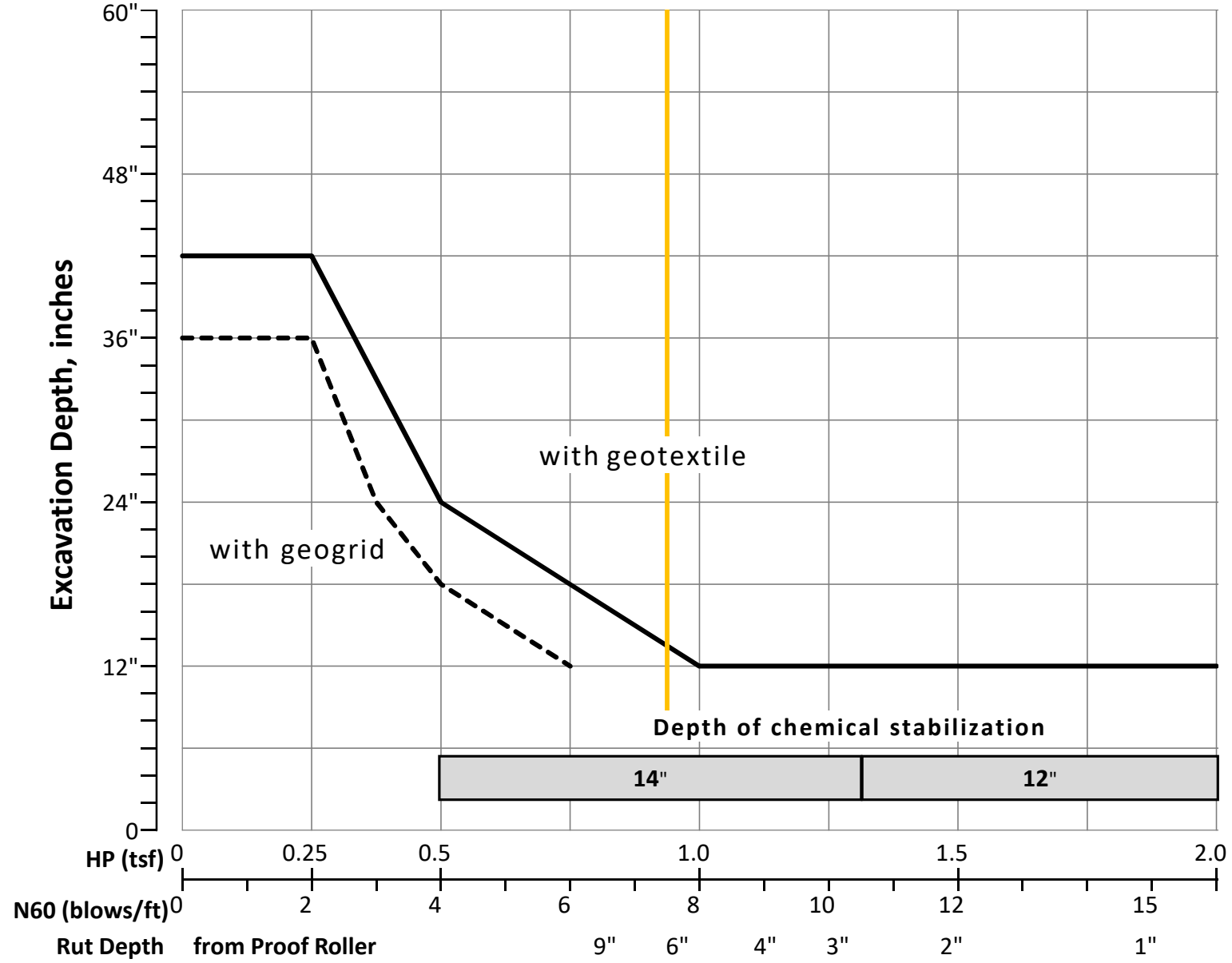
% Proposed Subgrade Surface	
Unstable & Unsuitable	90%
Unstable	90%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	11	8	2.20	28	17	14	34	23	57	19	13	7
Maximum	19	13	4.50	48	23	28	54	41	94	37	18	16
Minimum	4	4	1.00	0	0	3	1	0	1	2	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	3	2	2	0	0	0	0	0	1	0	0	10	3	0	2	0	0	23
Percent	0%	13%	9%	9%	0%	0%	0%	0%	0%	4%	0%	0%	43%	13%	0%	9%	0%	0%	100%
% Rock|Granular|Cohesive	0%	35%									65%								100%
Surface Class Count	0	0	0	2	0	0	0	0	0	1	0	0	7	0	0	0	0	0	10
Surface Class Percent	0%	0%	0%	20%	0%	0%	0%	0%	0%	10%	0%	0%	70%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.20		☐ HP
7.50		☐ N60L

Average HP
Average N_{60L}

APPENDIX VI

TENCATE SUBGRADE STABILIZATION DESIGN MEMORANDUM

Memo

To:	Brian Trenner, P.E. – Resource International, Inc.
From:	Santino Piccoli – TenCate Geosynthetics Americas
Cc:	
Date:	26 February 2020
Re:	FRA-70 6R Mirafi RS580i Geosynthetic Reinforced Subgrade Stabilization

As we discussed, I reviewed the test boring logs, cross section and profile info. I concur with Resource International's GB1 analysis indicating the N_{60L} of 6 for the subgrade analysis. Based on that and referencing GB1 Figure B, I correlated the N_{60L} value of 6 to an undrained shear strength of 750 psf (CBR 1.2%). Using the Giroud-Han (2004) design method, I back-calculated the design input parameters to achieve a 12-inch aggregate section on ODOT 712.15 geogrid using a design CBR of 1.2%. Subsequently, I then used those input parameters and performed a Giroud-Han analysis based on Mirafi RS580i, results indicating an equivalent performing section of 6 inches aggregate on the Mirafi RS580i.

The following information is attached for your reference and use:

- Giroud-Han (2004) Analyses results
- Suggested Plan Notes
- ODOT Item 204.07 – Spreading and Placing of Materials
- CSI Specification for Mirafi® RS580i (separate document in Word format)
- Example of ODOT Plan Note for DCP Testing

365 South Holland Drive
Pendergrass, GA 30567
Tel 706 693 2226
Tel 888 795 0808
Fax 706 693 4400
www.mirafi.com

TENCATE GEOSYNTHETICS

Date: 2/25/2020

FRA-70 6R
Short St. and Mound St. Subgrade Stabilization
ODOT GB-1 Back-calculation

Analysis for Unpaved Applications
Giroud-Han Method

Scenario: ODOT 712.15 Geogrid

Traffic Conditions				
*Wheel Load, P =	12	kips	53	kN
Tire Pressure, p =	80	psi	552	kPa
Number of Axle Passes, N =	1200	ea		
Allowable rut depth, s =	1.75	in	43.75	mm
Soil Conditions				
CBR_{bc} =	20	%		
CBR_{sg} =	1.2	%		
Equation Factors				
Calibration Factor, C_f =	0.236			
Rut depth factor, f_s =	3.0	in	75	mm
Wheel Load, P =	53	kN		
Radius of tire print, r =	0.175791	m		
Bearing Capacity Factor, N_c =	5.71			
Unreinforced N_c = 3.14				
Geotextile N_c = 5.14				
Geogrid Reinforced N_c = 5.71				
Factor relating CBR_{sg} to undrained cohesion (c_u), f_c =	30	kPa		
Modulus Ratio, $E_{bc}/E_{sg} = 3.48CBR_{bc}^{0.3}/CBR_{sg}$ =	7.123723			
Limited Modulus Ratio: min(Ebc/Esg,5.0), R_E =	5			

Required thickness, h = 0.2942 m 11.58 in

LIMITATIONS

1. **Subgrade CBR (CBR_{sg}) ≤ 5.**
2. **Maximum Axle Load is 40 kips. Wheel Load = Axle Load/2**
3. **Maximum Allowable Rut Depth, s is 3.0 inches**
4. **Minimum required aggregate thickness, h is 4.0 inches.**
5. **Modulus Ratio, E_{bc}/E_{sg} ≤ 5.**
6. **Method calibration required for all products.**

TENCATE GEOSYNTHETICS

Date: 2/25/2020

FRA-70 6R
Short St. and Mound St. Subgrade Stabilization
Mirafi® RS580i Geosynthetic Option

Analysis for Unpaved Applications
Giroud-Han Method

Scenario: **Mirafi® RS580i**

Traffic Conditions

*Wheel Load, P =	12	kips	53	kN
Tire Pressure, p =	80	psi	552	kPa
Number of Axle Passes, N =	1200	ea		
Allowable rut depth, s =	1.75	in	43.75	mm

Soil Conditions

CBR_{bc} =	20	%
CBR_{sg} =	1.2	%

Equation Factors

Calibration Factor, C_f =				
Rut depth factor, f_s =	3.0	in	75	mm
Wheel Load, P =	53	kN		
Radius of tire print, r =	0.175791	m		
Bearing Capacity Factor, N_c =	5.14			
Unreinforced N_c = 3.14				
Geotextile N_c = 5.14				
Geogrid Reinforced N_c = 5.71				
Factor relating CBR_{sg} to undrained cohesion (c_u), f_c =	30	kPa		
Modulus Ratio, $E_{bc}/E_{sg} = 3.48CBR_{bc}^{0.3}/CBR_{sg}$ =	7.123723			
Limited Modulus Ratio: min(Ebc/Esg,5.0), R_E =	5			

Required thickness, h = 0.1511 m 5.95 in

LIMITATIONS

1. **Subgrade CBR (CBR_{sg}) ≤ 5.**
2. **Maximum Axle Load is 40 kips. Wheel Load = Axle Load/2**
3. **Maximum Allowable Rut Depth, s is 3.0 inches**
4. **Minimum required aggregate thickness, h is 4.0 inches.**
5. **Modulus Ratio, E_{bc}/E_{sg} ≤ 5.**
6. **Method calibration required for all products.**

FRA-70 6R
Short Street and Mound Street Subgrade Stabilization
Columbus, OH

Mirafi RS580i Reinforced Subgrade Stabilization Plan Notes

1. RS580i *GEOSYNTHETIC* REINFORCED SECTION SHOULD EXTEND A MINIMUM 18 INCHES BEYOND THE EDGE OF THE SURFACE PAVEMENT OR PAVED SHOULDERS, INCLUDING UNDER NEW CURBS AND GUTTERS.

2. In the General Notes, include the standard plan note G121 “Item 204 – Subgrade Compaction and Proof Rolling”

3. ITEM 204, *GEOTEXTILE*, AS PER PLAN, MIRAFI RS580i
   FURNISH MIRAFI RS580i GEOTEXTILE FROM TenCate Geosynthetics Americas, Pendergrass, GA. INSTALL ACCORDING TO ITEM 204.07 B. GEOGRID. HAVE A REPRESENTATIVE FROM THE GEOSYNTHETIC MANUFACTURER PROVIDE ON-SITE TECHNICAL ASSISTANCE AT THE START OF THE WORK AND WHEN REQUIRED BY THE ENIGNEER OR CONTRACTOR.

4. Plan note for Dynamic Cone Penetrometer (DCP) – *see attached Ohio DOT Example*

365 South Holland Drive
Pendergrass, GA 30567

Tel 706 693 2226
Tel 888 795 0808

Fax 706 693 4400
www.tencategeo.com

204.07 Spreading and Placing of Materials. Place materials, conforming to 204.02, in 8-inch (200 mm) loose lifts. The Engineer may increase the lift thickness depending on the stability of the bottom of the excavation. The Engineer may increase the lift thickness up to 24 inches (600 mm) to obtain stability at the top of the lift. Doze, track, or manipulate the material to maximize the density and stability. Once stability is achieved, compact according to 204.03.

A. Geotextile. When specified, place geotextile fabric at the bottom of the undercut or at locations designated in the Contract Documents. Place the geotextile fabric smooth and free of tension or wrinkles. Fold or cut the geotextile fabric to conform to curves. Overlap a minimum of 18 inches (450 mm) at the ends and sides. Hold the geotextile fabric in place with pins or staples.

End dump the suitable material on the geotextile fabric. Do not operate the equipment directly on the geotextile fabric. Unless stated otherwise, spread the end dumped material and maintain a minimum lift thickness of 12 inches (300 mm).

When granular material Type E is specified or allowed, use a geotextile fabric on the top, bottom and around the Type E granular material to prevent piping of material into the Type E granular material. The Engineer may use granular material Type E when excess water is at the bottom of the undercut.

B. Geogrid. When specified, place geogrid at the bottom of the undercut or at locations designated in the Contract Documents. The geogrid may be attached to the underlying geotextile fabric when both materials are placed at the bottom of the excavation.

Roll out the geogrid longitudinally along the roadway, in line with the placement of the granular fill. Do not drag the geogrid across the subgrade. Place the geogrid smooth and free of wrinkles. Hold the geogrid in place with pins, staples, sandbags or piles of granular material to prevent movement during granular fill placement..

Cut the geogrid to conform to curves. Folding over the excess portion of the geogrid into the fill may be used as an alternative to cutting, if acceptable to the Engineer. Maintain the vertical position of the geogrid at the specified depth.

Overlap geogrid a minimum of 2.0 feet (0.6 m) at the ends and sides. Overlap geogrid 3.0 feet (0.9 m) in all directions if foot traffic causes movement of the subgrade. Place the beginning of each new roll beneath the previous roll to prevent the advancing fill from lifting the geogrid. Stagger end overlaps at least 10 feet (3.0 m) from other end overlaps in adjacent rolls or consecutive layers.

Place the granular material as specified in the Contract Documents. Cover the geogrid with material within three calendar days after placement. Place, spread, and compact the granular material in a manner that prevents the development of wrinkles or movement of the geogrid. Keep the geogrid taut during the placement of the initial lift.

End dump granular material on the geogrid. Do not operate construction equipment directly on the geogrid. Place the end dumped material along the roadway centerline and spread outward to the roadway edges. Unless stated otherwise, maintain a minimum lift thickness of 12 inches (300 mm) for the lift

immediately above the geogrid. Do not turn equipment or brake suddenly on the first lift of material over the geogrid.

Fill in any ruts that form during construction by adding material. Do not cut down the fill between the ruts. If rut depths exceed 3 inches (75 mm), reduce the size, weight, or both of the equipment. The Engineer may increase the lift thickness to obtain stability at the top of the lift. The Engineer may waive density requirements for the first lift if the subgrade is too soft to support compaction equipment.

Patch damaged geogrid. Place a geogrid patch that extends at least 3.0 feet (0.9 m) beyond the damaged area in all directions. If the damaged portion is larger than 50 percent of the roll width, cut across the entire width of the roll to remove the damaged portion and overlap the cut ends. Replace or repair damaged geogrids at no expense to the Department.

204.08 Method of Measurement. The Department will measure Subgrade Compaction by the number of square yards (square meters) computed from the profile grade and typical sections and actually compacted. The Department will measure 18 inches (450 mm) beyond the edge of the pavement surface, paved shoulders, and paved medians. The Department will measure the surface area of the paved driveways, paved mailbox turnouts, curb, and gutter.

The Department will measure Proof Rolling by the number of hours accepted. The Department will not measure idle time for repairs, servicing, loading and unloading ballast, adjusting tire pressure, bad weather, wet subgrade, usage at times and at locations other than Department directed, and stand-by time to be available when next needed or other cause for stand-by time.

The Department will measure Excavation of Subgrade; Embankment; Granular Embankment; and Granular Material, Type according to 203.09. All excavation is unclassified.

The Department will measure Geotextile Fabric by the number square yards (square meters) of surface area of geotextile fabric placed. The Department will not include overlaps in the measurement.

The Department will measure the quantity of Geogrid by the number of square yards (square meters) of subgrade covered by the geogrid. The Department will not include overlaps in the measurement.

204.09 Basis of Payment. The Department will pay according to 109.05 for changes or extra work that increases the haul distance more than a 1/2 mile (1 km) to the work detailed in the Contract Documents. The Department will pay for additional quantities that increase the haul distance 1/2 mile (1 km) or less at the unit bid price.

If unstable subgrade results from inadequate surface drainage or lack of maintenance, as required by 203.04.A, the Department will not pay for replacing the unstable subgrade and disposing of the removed material.

For problems identified in 204.06 that are the result of soils or conditions at lower elevations than the Contract work, the Department will pay for the corrections.

EXAMPLE ODOT PLAN NOTE FOR DCP TESTING

ITEM 204, EXCAVATION OF SUBGRADE, AS PER PLAN

FIVE DAYS PRIOR TO THE REMOVAL OF CONCRETE PAVEMENT SLABS FOR REPLACEMENT, THE CONTRACTOR WILL NOTIFY THE PROJECT ENGINEER OF THE UPCOMING REPLACEMENTMENT WORK AND ASSOCIATED WORK SCHEDULE. THE PROJECT ENGINEER WILL IMMEDIATELY CONTACT THE ODOT'S OFFICE OF GEOTECHNICAL ENGINEERING TO COORDINATE DYNAMIC CONE PENETROMETER (DCP) TESTING WITH THE CONTRACTOR'S WORK SCHEDULE. A DCP WILL BE USED FOR TESTING THE STABILITY AND UNIFORMITY OF THE EXISTING LIME-STABILIZED SUBGRADE THAT LIES BELOW THE SLABS TO BE REPLACED. THE DCP TESTING WILL BE CONDUCTED PER ASTM D6951/D6951M-09 STANDARD TEST METHOD. ODOT'S OFFICE OF GEOTECHNICAL ENGINEERING WILL BE PROVIDING THE DCP TESTING AND RESULTS.

ONCE THE UNSATISFACTORY, EXISTING CONCRETE PAVEMENT SLABS AND THE UNDERLYING AGGREGATE BASE HAVE BEEN REMOVED, ODOT WILL CHOOSE THE LOCATION OF THE DCP TEST, AND THE DCP TESTING WILL BE PERFORMED ON TOP OF THE UNDISTURBED, EXISTING LIME-STABILIZED SUBGRADE. THE CONTRACTOR WILL ASSIST IN PREPARING A MINIMUM 2 FEET BY 2 FEET TESTING LOCATION AS DIRECTED BY AND TO THE SATISFACTION OF THE PROJECT ENGINEER.

THE DCP WILL MEASURE THE PENETRATION RATE (PR) IN MILLIMETERS/BLOW (MM/BLOW) FOR THE PREVIOUSLY LIME-STABILIZED SUBGRADE THROUGH THE 16 INCH TREATMENT DEPTH. A TEST WILL BE PERFORMED EVERY 200 LINEAR FEET WITH A MINIMUM OF ONE TEST AT EACH REPAIR SECTION. THE PENETRATION RATE THROUGH THE LIME-STABILIZED SUBGRADE MUST AVERAGE THE MINIMUM RATE THAT CAN BE CORRELATED TO THE DESIGN CBR VALUE OF 10. IF THE RATE DOES NOT CORRELATE WITH A CBR VALUE OF 10, THE PREVISOUSLY LIME-STABILIZED SUBGRADE NEEDS TO BE REMOVED AND RECONSTRUCTED AS PER THESE PLANS.

THE RESULTS PROVIDED BY THE ODOT'S OFFICE OF GEOTECHNICAL ENGINEERING WILL BE PROVIDED TO THE CONTRACTOR AND THE PROJECT ENGINEER. THE PROJECT ENGINEER WILL DIRECT THE CONTRACTOR ON HOW TO PROCEED WITH THE WORK ASSOCIATED WITH REPLACING THE CONCRETE PAVEMENT SLAB(S). IT IS ANTICIPATED THE TESTING AND RESULTS WILL BE AVAILABLE WITHIN ONE HOUR OR LESS. ANY DELAYS ASSOCIATE WITH THE TESTING AND AWAITING RESULTS SHALL BE CONSIDERED INCIDENTAL TO ITEM 204, EXCAVATION OF SUBGRADE, AS PER PLANS.

ALL LABOR, EQUIPMENT, MATERIALS AND IDLE TIME NECESSARY TO PREPARE THE SUBGRADE FOR THE DCP TESTING AND AWAITING FURTHER DIRECTION SHALL BE INCLUDED IN THE UNIT PRICE BID FOR ITEM 204, EXCAVATION OF SUBGRADE, AS PER PLAN.

Project Name:
Project Number:

Section 31 21 19

Specification for Geotextile Used in Subgrade Stabilization/Restraint and Base Reinforcement Applications

1. GENERAL

1.1 SECTION INCLUDES

A. Geotextile to stabilize and reinforce an aggregate cover material (subbase, base, select embankment, etc.) of an unpaved or paved roadway.

1.2 RELATED SECTIONS

A. Section 02 50 00 – Site Remediation
B. Section 01 89 13 – Site Preparation Performance Requirements
C. Section 31 00 00 – Earthwork
D. Section 32 10 00 – Bases, Ballasts, Pavements and Appurtenances

1.3 UNIT PRICES

A. Method of Measurement: By the square yard (or square meter – as indicated in contract documents) including seams, overlaps and wastage.

B. Basis of Payment: By the square yard (or square meter – as indicated in contract documents) installed.

1.4 REFERENCES

A. AASHTO Standards

1. T088-10-UL – Particle Size Analysis of Soils
2. T090-00-UL – Determining the Plastic Limit and Plasticity Index of Soils
3. T099-10-UL – The Moisture-Density Relations of Soils Using a 5.5 lbs. (2.5 kg) Rammer and a 12-inch (305 mm) Drop.
4. M288 – Geotextile Specification for Highway Applications

B. American Society for Testing and Materials (ASTM):

1. D422 – Standard Method for Particle-Size Analysis of Soils
2. D4354 – Practice for Sampling of Geosynthetics for Testing
3. D4355 – Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

4. D4439 – Terminology for Geosynthetics
5. D4491 – Test Methods for Water Permeability of Geotextiles Permittivity
6. D4595 – Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
7. D4751 – Test Method for Determining Apparent Opening Size of Geotextile
8. D4759 – Practice for Determining the Specification Conformance of Geosynthetics
9. D4884 – Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles
10. D4873 – Guide for Identification, Storage and Handling of Geotextiles
11. D5321 – Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
12. D6241 – Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50 mm Probe
13. D6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
14. D8102 – Standard Practice for Manufacturing Quality Control of Geotextiles

C. Geosynthetic Accreditation Institute (GAI) – Laboratory Accreditation Program (LAP)

D. International Standards Organization (ISO) – 9001:2015

E. National Transportation Product Evaluation Program (NTPEP)

1.5 DEFINITIONS

A. Minimum Average Roll Value (MARV): As determined by ASTM D8102, property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.6 SUBMITTALS

A. Submit the following:

1. Certification: The contractor shall provide to the Engineer a certificate stating the name of the manufacturer, product name, style number and chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. The certification shall state the furnished geotextile meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program per ASTM D8102 and include supporting QC test results. The Certification shall be attested to by a person having legal authority to bind the Manufacturer. Certifications from Private Label distributors shall not be accepted.

2. If an alternate product is submitted, full scale performance testing performed by an independent testing agency shall be provided to the Engineer that quantifies the structural benefit of the geotextile. The benefit must meet or exceed the benefit of the design geotextile under similar conditions.

3. Coefficient of Interaction (C_i) test results performed by a laboratory with GRI accreditation should be provided to confirm conformance to the specified value.

4. Manufacturer's installation guidelines shall be provided.

5. One (1) 1 ft. x 1 ft. sample shall be provided.

6. Quality Standards: The contractor shall provide to the Engineer the Manufacturer's Quality Control Plan along with their current GAI-LAP and ISO 9001:2015 certificates.

7. Alternate products must be submitted to engineer 15 days prior to bid date and should include information on five similar projects in size and scope.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The geotextile Manufacturer shall have all the following credentials:

a. ISO 9001:2015 Quality Management System

b. Geosynthetic Accreditation Institute (GAI) Laboratory Accreditation Program (LAP).

B. The geotextile Manufacturer shall have a GAI-LAP accredited laboratory at the location of production or receiving location capable of performing the ASTM tests as outlined in the specification.

1.8 DELIVERY, STORAGE AND HANDLING

A. Geotextile labeling, shipment and storage shall follow ASTM D4873. Product labels shall be color-coded to specifically identify each product and clearly show the Manufacturer's name, style name and roll number. The geotextile shall be labeled directly on the product at an interval not greater than every 5 meters (15 feet) indicating the product name and manufacturing number per NTPEP GTX labeling requirements.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight and contaminants.

C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures and any other environmental conditions that may damage the physical property values of the geotextile.

2. PRODUCTS

2.1 MANUFACTURERS

A. TenCate Geosynthetics Americas
365 South Holland Drive
Pendergrass, GA, USA 30567
1-800-685-9990
1-706-693-2226
www.tencategeo.us

2.2 MATERIALS

A. Geotextile:

1. The geotextile with orange identification yarns and super high-tenacity polypropylene yarns with a weave pattern to maximize strength, water flow, soil interaction and soil retention. The yarns shall be from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

2. The geotextile shall meet the requirements of Table 1. All numeric values in Table 1 except AOS represent Minimum, MARV or Typical in the specified direction. Values for AOS represent maximum average roll values.

3. All geotextile products shall have a separation factor of 0.9 or higher per ASTM D422, Modified.

TABLE 1 – SUBGRADE STABILIZATION GEOTEXTILE

When sewn seams are required, refer to **Section 3 – Execution**.

Roadway Design and Performance Properties	Guidance Document / Test Method	Unit	Design / Calibration Value	
Base Course M_R Improvement Factor[1]	AASHTO R50-09	---	1.40	
Subgrade M_R Improvement / Increase[2]	AASHTO R50-09	lb/in^2 (MPa)	9,000 (62.0)	
Cyclic Tensile Modulus: J_{cyclic}[3]	ASTM D7556	kip/ft (kN/m)	MD	CD
			60 (876)	160 (2,336)
Resilient Interface Shear Stiffness: G_I[3]	ASTM D7499	kip/in^2 (MPa)	329 (2,268)	
Traffic Benefit Ratio: TBR[4,5,6]	AASHTO R50-09	---	9.0 / 13.1 / 39.0	
Interaction Coefficient: C_i[7]	ASTM D6706	---	0.90	
Pore Pressure Dissipation Ratio[4]	Measured	---	2.0	
Typical Dynamic Filtration Pore Size O_{95} / O_{50} [8]	ASTM D6767	microns	337 / 192	
Maximum Percent Open Area: MPOA[9]	ASTM D6767	Percent	7.3	
Tensile Strength @ 2% Strain (MARV)	ASTM D4595	lb/ft (kN/m)	480 (7.0)	1,800 (26.3)
Tensile Strength @ 5% Strain (MARV)	ASTM D4595	lb/ft (kN/m)	1,440 (21.0)	4,380 (63.9)

Index Properties	Test Method	Unit	Roll Value
Apparent Opening Size, AOS (Maximum Roll Value)	ASTM D4751	U.S Sieve (mm)	40 (0.425)
Hydraulic Flow Rate (MARV)	ASTM D4491	gal/min/ft^2 (l/min/m^2)	75 (3,056)
Permittivity (MARV)	ASTM D4491	sec^{-1}	1.0
UV Resistance (at 500 hours exposure)	ASTM D4355	% strength retained	90

Notes:

[1] Value Determined from Results of Independent Testing Performed at Kansas State University in accordance with NCHRP Report 512 "Accelerated Pavement Testing: Data Guidelines" and AASHTO R50-09 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures." Multiplier for Unbound Granular Material; for SG M_R between 4.5 and 6.9 ksi (30.9 and 47.4 MPa).

[2] Value Determined from Results of Independent Testing and Geosynthetic Calibrations to AASHTOWare ME Reported by NCHRP 01-50 "Quantifying the Influence of Geosynthetics on Pavement Performance." Subgrade M_R Increase for SG M_R between 5 and 25 ksi (69 and 172 MPa).

[3] Value Determined from Results of Independent Testing and Geosynthetic Calibrations Reported by WTI / MTSU "Relative Operational Performance of Geosynthetics Used as Subgrade Stabilization." Cyclic Tensile Modulus Measured at 2% Permanent Strain; Resilient Interface Shear Stiffness Normal Stress = 5.08 psi (35 kPa); Interface Shear Stress = 0.73 psi (5 kPa).

[4] Value Determined from Results of Independent Testing Performed at GeoTesting Express (GeoComp) "A Laboratory Evaluation of the Performance of TenCate Mirafi® Geosynthetics in Roadway Stabilization Applications – Georgia Silt Subgrade," September 1, 2011. 9-kip {40 kN} Wheel Load, SG CBR = 1%, 12-inch (300-mm) Crushed Aggregate BC (CBR > 25%), 3-inch (75-mm) Rut Depth.

[5] Value Determined from Results of Independent Testing Performed at LTRC "Performance of Reinforced–Stabilized Unpaved Test Sections Built Over Native Soft Soil Under Full-Scale Moving Wheel Loads," TRR Volume 2511, 2015. Measured at 0.34-inch (8.64 mm) Rut Depth; Peak Pore Pressure 6-inches (150 mm) Below Geosynthetic.

[6] Value Determined from Results of Independent Testing Performed at GeoTesting Express (GeoComp) "A Laboratory Evaluation of the Performance of TenCate Mirafi® Geosynthetics in Roadway Stabilization Applications – Montana Clay Subgrade," September 1, 2011. 9-kip (40 kN) Wheel Load, SG CBR = 1.8%, 8-inch (200-mm) Rounded Aggregate BC (CBR > 25%), 3-inch (75-mm) Rut Depth.

[7] Interaction Coefficient value is for sand (SP) or gravel (GW) based on testing conducted by SGI Testing Services.

[8] Typical Value Determined from Specimen Results of Independent Testing Performed at TRI Environmental, Various Dates.

[9] Maximum Value Determined from Specimen Results of Independent Testing Performed at TRI Environmental, Various Dates.

4. Approved geotextiles are as follows:

TenCate Geosynthetics Mirafi® RS580i

2.3 QUALITY CONTROL

A. Manufacturing Quality Control: Testing shall be performed at an on-site laboratory accredited by GAI-LAP for tests required for the geotextile at frequency meeting or exceeding ASTM D4354.

B. Manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D4354. A lot size for conformance or quality assurance sampling shall be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

3. EXECUTION

3.1 See Manufacturer's installation guidelines provided in the submittal.

END OF SECTION